NEWSLETTER

CLOVERS AND SPECIAL PURPOSE LEGUMES RESEARCH

Vol. 4--1970

Compiled by the Forage and Range Research Branch
Crops Research Division, Agricultural Research Service
U.S. Department of Agriculture, Beltsville, Maryland

TABLE OF CONTENTS

INTRODUCTION

Upon Mr. Henson's recent retirement (see page 23), the files of his Special Purpose Legumes office are placed in my hands. My brief acquaintances with such files already reveal the breadth of knowledge C. V. Piper, A. J. Pieters, Roland McKee, Eugene Hollowell, and P. R. Henson possessed on Leguminoseae. Will one individual ever acquire this knowledge again?

The objective of the NEWSLETTER -- Clovers and Special Purpose Legumes Research -- is the informal exchange of research information on the many species of forage legumes other than alfalfa. In scope, the Newsletter includes research information on the adaptation, breeding, management, and seed production of these legumes.

The contents of each volume include voluntary contributions compiled without editing. We encourage the use of this medium for the exchange of research information not available via other media. We hope the Newsletter will serve to disseminate current research information until research conferences can again be held on the main species involved. In this spirit we solicit progress reviews of your research programs on the species with which you work.

We welcome contributions and suggestions in future issues of the Newsletter. Reports and other information for the next issue may be sent to:

Robert C. Leffel
Forage and Range Research Branch, CR
Room 335, South Building
Plant Industry Station
Beltsville, Maryland 20705

***

ALABAMA

Arrowleaf Clover, Crownvetch, and Sericea Lespedeza

Carl S. Hoveland (Auburn)

Yuchi arrowleaf clover (*Trifolium vesiculosum*). Grazing studies with steers were conducted for 2 years on a droughty, eroded clay soil of the Piedmont. Steers grazing Abruzzi rye-annual ryegrass-Yuchi arrowleaf clover continuously with no supplement from December to June had an average daily gain of 2.05 lb in 1967-68 and 2.39 lb in 1968-69. Net return per steer for management, capital, and interest averaged $102 the first year and $152 the second year. Rye furnished most of the early season forage, and Yuchi arrowleaf produced most of the grazing from early April to June. Ryegrass furnished grazing in late February and March when rye was booting.

Acreage of Yuchi arrowleaf for grazing continues to increase rapidly while crimson clover acreage declines in Alabama. An indication of this is the acreage of clover for certified seed production: Yuchi arrowleaf, about 3,000, and crimson, about 500 acres. In addition, there is a very large acreage of Yuchi arrowleaf grown for uncertified seed. The decline in crimson clover acreage can be attributed to high cost of seed (larger amount of crimson needed for seeding than of arrowleaf), susceptibility of crimson to head weevil, and short productive season.

Crownvetch. A 3-acre area of Emerald crownvetch was planted in March 1969 at the Piedmont Substation using 10 lb/A seed and 4 lb/A vernolate. Excellent crownvetch stands and weed control were obtained. Growth was poor in 1969 and no grazing was done. Growth was poor the spring of 1970, and it appears that little grazing will be available this year.

Sericea lespedeza. Acreage of the new Serala sericea variety continues to expand rapidly as seed becomes available. Demand for seed has been strong from other states as well as Alabama.

Since sericea seedlings are weak and compete poorly with weeds, high seeding rates have been recommended. Even so, no forage is obtained the establishment year. Field experiments at two locations helped solve the problem of getting good sericea stands. Reducing the sericea seeding rate from the presently recommended 30 lb/A to 10 lb/A and applying 3 lb/A vernolate herbicide preplant was the most economical and productive method of establishment. Sericea yields the year of establishment were increased 2 to 10 times when vernolate was applied. Application of vernolate with a low seeding rate permitted a cutting of hay in early August or grazing during the year of establishment with only a small reduction in yield the following year.

Publications:

1. Donnelly, E. D. and W. B. Anthony. 1970. Effect of genotype and tannin on dry matter digestibility in sericea lespedeza. Crop Sci. 10:200-202.

2. Donnelly, E. D. and R. M. Patterson. 1969. Effect of irrigation and clipping on seed production and chosmogamy of sericea genotypes. Agron. J. 61:501-502.

3. Donnelly, E. D., Ray Dickens, D. G. Sturkie, and J. D. Miller. 1970. Interstate sericea lespedeza--a multi-purpose legume. Auburn Univ. Agr. Exp. Sta. Leaflet 80.

4. Hoveland, C. S., G. A. Buchanan, and E. D. Donnelly. 1970. Establishing sericea lespedeza at low seeding rate with herbicide. Auburn Univ. Agr. Exp. Sta. Circ. 174.

5. Hoveland, C. S., E. L. Carden, W. B. Anthony, and J. P. Cunningham. 1970. Management effects on forage production and digestibility of Yuchi arrowleaf clover (*Trifolium vesiculosum* Savi). Agron. J. 62:115-116.

6. Hoveland, C. S., E. L. Carden, G. A. Buchanan, E. M. Evans, W. B. Anthony, E. L. Mayton, and H. E. Burgess. 1969. Yuchi arrowleaf clover. Auburn Univ. Agr. Exp. Sta. Bull. 396.

7. Hoveland, C. S. and E. M. Evans. 1970. Cool season perennial grass-clover management. Auburn Univ. Agr. Exp. Sta. Circ. 175.

8. Johnson, W. C., E. D. Donnelly, and P. B. Gibson. 1970. Registration of Regal ladino clover. Crop Sci. 10:208.

***

CANADA

Legumes with Lincoln Bromegrass

A. T. H. Gross (Brandon, Manitoba)

In 1968 several legumes were established in simple mixtures with Lincoln bromegrass to evaluate their performance in comparison with alfalfa-bromegrass as the standard. The tests were seeded on clay loam soil which had been summerfallowed the previous year. Row spacings were 12 inches (30.48 cm) and 4 replicates were used.

In 1969 the hay test was cut on July 10 and August 19; the pasture test was cut on June 11, July 17, and August 18. Stand was recorded on September 8. Samples from each cutting were held in the freezing chamber until time was available to undertake hand separation of components, following which samples were oven dried and weighed; the legume percent of yield is reported on dry weight basis.

None of the legumes contributed as much to the stand or to yield as alfalfa. Eski sainfoin in the pasture test contributed as much to yield as Vernal alfalfa in the hay test. Evaluation will continue for at least two years to determine trends.

HAY TEST:

Legume in mixture with Lincoln bromegrass	% of Stand		Legume % of Yield		
	Legume	Grass	1st cut	2nd cut	Season
Astragalus cicer	2.4	97.6	9.0	3.2	8.2
Crownvetch	2.5	97.5	10.0	1.1	8.7
Leo birdsfoot trefoil	3.7	96.3	2.3	4.2	2.6
Astragalus canadensis	1.2	98.8	9.6	2.4	8.5
Krasnodar sainfoin	2.0	98.0	10.2	10.4	10.2
Vernal alfalfa	27.3	72.7	18.3	39.6	23.3

PASTURE TEST:

Legume in mixture with Lincoln bromegrass	% of Stand		Legume % of Yield			
	Legume	Grass	1st cut	2nd cut	3rd cut	Season
Astragalus cicer	12.1	87.9	8.1	12.6	9.7	9.8
Crownvetch	5.2	94.8	9.4	12.7	9.5	9.9
Leo birdsfoot trefoil	4.1	95.9	9.3	16.5	11.2	10.8
Zigzag clover	4.4	95.6	13.5	10.2	2.7	11.2
Eski sainfoin	7.3	92.7	30.0	20.2	16.5	25.9
Rambler alfalfa	44.7	55.3	42.2	66.5	78.0	55.4

Publications

A publication which may be of interest to readers of the Newsletter is: Stevenson, G. A. 1969. An agronomic and taxonomic review of the genus Melilotus Mill. Canad. J. Plant Sci. 49:1-20. Copies are available from the Research Station, Brandon.

***

Uniform Regional Birdsfoot Trefoil Test 1969

B. P. Goplen (Saskatoon, Saskatchewan)

Cooperators: H. Gross, A. K. Storgaard, D. A. Cooke, W. L. Crowle, D. H. Heinrichs, P. Pankiw, L. P. Folkins, M. R. Hanna, W. A. Hubbard

Summary of 1969 Results

1. Leo and S'toon Comp. are approximately equal and superior in forage yield of the trefoil varieties tested. In summarizing data from 1960-69 involving 59 station years, these two varieties compare as follows:

	Forage yield (T/A)	Seed yield (#/A)	Seedling vigor (1-9)
Leo	2.24	437	1.9
S'toon Comp.	2.20	463	1.8

2. Viking lacks sufficient winter hardiness but serves as a useful entry in recording relative hardiness. Viking yields as well as Leo in the absence of winter killing (cf. Kamloops data).

3. Wallace, Winnar, MC-F-67, and Viking are generally inferior in forage and seed yields and lower in seedling and spring vigor.

Uniform Regional Birdsfoot Trefoil Test--1969 Data

Forage yield in tons DM/A (% of Empire in brackets)

Station	Saskatoon	Beaverlodge	Kamloops	
Year seeded	1968	1968	1968	3-sta.
Number of cuts	1	1	3	avg.
Empire	2.31 (100)	1.25 (100)	3.91 (100)	2.49 (100)
Leo	2.73 (118)	1.60 (128)	4.28 (109)	2.87 (115)
MC-H-67	2.19 (95)	1.44 (115)	4.15 (106)	2.59 (104)
MC-F-67	2.24 (97)	1.40 (112)	4.08 (104)	2.57 (103)
S'toon Comp.	2.43 (105)	1.37 (110)	3.85 (98)	2.55 (102)
Viking	1.64 (71)	.96 (77)	4.27 (109)	2.29 (92)
Wallace	2.18 (94)	1.08 (86)	3.52 (90)	2.26 (91)
Winnar	1.98 (86)	1.16 (93)	3.71 (95)	2.28 (92)
Beaver (alfalfa)	3.55 (154)	1.10 (88)	6.16 (158)	3.60 (145)
Mean (trefoil)	2.21	1.28	3.97	2.49
Trefoil/alfalfa %	62%	116%	64%	69%

Seed Yield in lb/A (% of Empire in brackets)

Station	Melfort	Saskatoon	Beaverlodge	3-sta.
Year Seeded	1966	1968		avg.
Empire	268 (100)	94 (100)	365 (100)	342 (100)
Leo	255 (95)	74 (79)	564 (155)	298 (87)
MC-H-67	262 (98)	67 (71)	565 (155)	398 (116)
MC-F-67	144 (54)	62 (66)	582 (159)	263 (77)
S'toon Comp.	269 (100)	100 (106)	579 (159)	316 (92)
Viking	w.k.	61 (65)	299 (82)	180 (53)
Wallace		83 (88)	489 (134)	286 (84)
Winnar	299 (112)	81 (86)	527 (144)	302 (88)
Fargo	257 (96)			257 (75)
Beaver (alfalfa)	255 (95)	-	29 (8)	142 (42)
Mean (trefoil)	251	78	496	294

Melfort

Seed Test--Seeded 1966

Variety	Spring stand (1-9)	Bloom date (June 1 - bloom)	Height at harvest (in.)	Seed yield lb/A
Empire	1.3	33	9	268
Fargo	1.2	35	9	257
Leo	1.2	30	10	255
MC-H-64	1.0	33	10	262
MC-F-65	1.8	28	8	144
S'toon Comp.	1.2	30	9	269
Winnar	1.2	30	9	299
Viking	w.k.	w.k.	w.k.	w.k.
Beaver (alfalfa)	1.0	34	19	255
Mean	1.2	32	11	251
LSD (.05)	n.s.	.6	1.12	68
LSD (.01)	n.s.	.7	1.51	92
S.E. var. mean	-	.26	.55	34
C.V.	39%	2%	9%	23%

Comments: Viking killed out due to its lack of winter hardiness. There is little to choose among the trefoil varieties in seed yield except that MC-F-65 is inferior.

Saskatoon

Forage Test--Seeded 1968

Variety	Spring stand (1-9)	Spring vigor (1-9)	Forage yield (1 cut) tons DM/A
Empire	93	5.2	2.31
Leo	100	2.2	2.73
MC-H-67	99	2.6	2.19
MC-F-67	98	3.4	2.24
S'toon Comp.	99	3.2	2.43
Viking	92	4.8	1.64
Wallace	89	4.4	2.18
Winnar	99	4.4	1.98
Beaver (alfalfa)	100	1.0	3.55
Mean	96	3.5	2.36
LSD (.05)	5	.8	.50
LSD (.01)	6	1.0	.68
S.E. var. mean	2.4	.38	.25
C.V.	4%	17%	17%

Seed Test--Seeded 1968

Variety	Spring stand (1-9)	Spring vigor (1-9)	Seed yield lb/A
Empire	83	5.0	94
Leo	100	2.2	74
MC-H-67	96	2.8	67
MC-F-67	96	3.4	62
S'toon Comp.	100	3.4	100
Viking	95	5.0	61
Wallace	95	5.2	83
Winnar	94	4.4	81
Beaver (alfalfa)	98	1.0	-
Mean	95	3.6	78
LSD (.05)	7	.7	n.s.
LSD (.01)	9	.9	n.s.
S.E. var. mean	3.3	.35	16
C.V.	5%	15%	33%

Comments: The main conclusion drawn from these tests is that Leo and S'toon Comp. are approximately equal and superior in seed and forage yields. Viking is definitely inferior due to its lack of hardiness; the strains MC-H-67, MC-F-67, Wallace, and Winnar appear to have little to offer in relative performance. Alfalfa yielded approximately 3/4 tons more per acre than the best trefoils. Considerable seed shattering occurred before the seed test was harvested, which accounts for the generally low seed yields.

Beaverlodge

Forage test--Seeded 1968

Variety	Fall stand % (1968)	Spring stand % (1969)	W.K. (%)	Date of bloom (June 1--10% bloom)	Forage yield tons DM/A
Empire	97	94	3	20	1.25
Leo	97	96	0	16	1.60
MC-H-67	97	96	0	9	1.44
MC-F-67	97	97	0	9	1.40
S'toon Comp.	97	96	1	18	1.37
Viking	96	94	2	9	.96
Wallace	97	95	2	21	1.08
Winnar	98	95	3	21	1.16
Beaver (alfalfa)	93	92	1	16	1.10
Mean	97	95	2		1.26
LSD (.05)	1.5	2	1		.14
LSD (.01)	2	3	2		.18
S.E. var. mean	.76	1.12	.71		.07
C.V.	1%	2%	78%		9%

Seed Test--Seeded 1968

Variety	Fall stand % (1968)	Spring stand % (1969)	W.K. (%)	(June 1--bloom)	(June 1--harvest)	Seed yield lb/A
Empire	96	92	4	19	78	365
Leo	95	93	1	15	71	564
MC-H-67	94	92	2	8	71	565
MC-F-67	94	93	1	8	69	582
S'toon Comp.	95	92	2	17	75	579
Viking	94	90	4	8	67	299
Wallace	94	91	3	20	77	489
Winnar	95	91	5	20	78	527
Beaver (alfalfa)	91	89	2	15	108	29
Mean	94	91	3	14	77	444
LSD (.05)	2	2	1	.26	1.3	72
LSD (.01)	3	3	2	.35	1.7	96
S.E. var. mean	1.10	.95	.71	.13	.65	36
C.V.	2%	2%	44%	2%	1%	14%

Comments: Leo was the highest in forage yield with S'toon Comp., with MC-H-67 and MC-F-67 next in performance. Viking, Wallace, and Winnar were mediocre in forage yield. Viking and Empire were lowest in seed yield. Alfalfa yielded less forage (P = .01) than the best trefoil varieties.

Kamloops

Forage Test--Seeded 1968

	Forage yield--tons DM/A			
Variety	1st cut	2nd cut	3rd cut	Total
Empire	1.73	1.51	.67	3.91
Leo	2.03	1.60	.65	4.28
MC-H-67	1.80	1.69	.66	4.15
MC-F-67	1.61	1.66	.82	4.08
S'toon Comp.	1.72	1.43	.71	3.85
Viking	1.85	1.51	.91	4.27
Wallace	1.55	1.38	.59	3.52
Winnar	1.56	1.48	.68	3.71
Beaver (alfalfa)	2.64	2.08	1.45	6.16
Mean	1.83	1.59	.79	4.21
LSD (.05)	.32	.23	.09	.38
LSD (.01)	.42	.31	.12	.50
S.E. var. mean	.16	.12	.05	.19
C.V.	15%	13%	10%	8%

Comments: In the absence of winter killing and injury the high forage potential of Viking is realized and is equal to Leo. Similarly, MC-H-67 and MC-F-67 yield well. Wallace and Winnar yield least in forage. Alfalfa yields more than 2 tons per acre more forage than trefoil. This is probably a result of much faster recovery after cutting which provides considerable differential in yield under the 3-cut system.

***

Potential Legumes for Shallow Soil Pastures

E. M. Watkin and J. E. Winch (Guelph, Ontario)

Over one million acres of roughland pasture in southern Ontario are characterized by shallow soils (0-12 in. over limestone bedrock). Canada bluegrass (*Poa compressa* L.) is the major species, but it has low productivity and a poor seasonal distribution of yield. These characteristics, coupled with extreme summer drought, necessitate 30 to 40 acres to support one animal unit during the May to September grazing season.

Birdsfoot trefoil (*Lotus corniculatus* L.) which has been used to improve the productivity of deeper pasture soils ($<$ 12 in.) fails to persist on the shallower soils. Although good stands are obtained in the seeding year, these are greatly reduced the year after seeding, and only isolated plants remain the second and third years after seeding.

In 1968 a preliminary program was begun to find a forage legume for shallow soil pastures. Some 49 species totalling 139 varieties and strains were initially studied. Rod rows and replicated broadcast seedings were made in 1968 and 1969, respectively. In the 1969 trials, species were broadcast in mixture with granular dalapon (5 lb ai./A) and 100 lb/A 0-46-0; in the fall 20 lb/A 0-20-20 was applied.

Plot size varies from 40' x 40' to 20' x 6', depending upon the availability of seed. Yield data and notes taken in June 1970 are given for the most promising species.

Dry Matter Yield in lb/A

Species	1st cut June 8	1st cut June 24	Regrowth
Vicia villosa	2373	--	Poor
Coronilla varia cv. Chemung	1652	3340	Good
Anthyllis vulneraria	2027	3338	Good
Alfalfa cv. Can-Creep	2258	--	Medium
Ranger	2026	--	Medium
Rambler	1812	--	Medium
Medicago lupilina	1173	1976	Medium
Native pasture	--	1226	Poor

Observations on regrowth were made on June 24 and apply to plots harvested on June 8. Unlike *Lotus corniculatus*, stands of *Coronilla varia*, *Anthyllis vulneraria*, and alfalfa have shown steady improvement during spring 1970. On June 24 severe moisture stress was apparent in all species under test except *C. varia* and *A. vulneraria*.

Publications:

1. Watkin, E. M. and Winch, J. E. 1970. Assessment and improvement of roughland pastures in Ontario. A.R.D.A. Research Report, Ontario Department of Agriculture and Food, Toronto. 54 pp.

***

FLORIDA

Evaluation of Several Cool Season Clovers and Lupine

Leonard S. Dunavin (Jay)

Six replications of these clovers and lupine were planted on October 10, 1969, on a Red Bay fine sandy loam soil. Plots were 7' x 12' in size. Irrigation was utilized in November and again in May during very dry periods, and probably more irrigations were needed. The winter of 1969-70 was unusually cold for this area. Periods when good grazing would have been available in 1969-70 from these legumes were rather limited. Additional harvests from the arrowleaf and white clovers will be possible after the deadline for this report. Data are presented in Table 1, and information from the two previous years is included for comparison.

Another lupine trial was conducted in 1969-70 on a soil grading from Tifton to Red Bay fine sandy loam. This trial was planted on November 12, 1969. Forage yields were determined from a single harvest on April 16, and seed yields were taken on May 25. Dry weather resulted in a considerable loss of seed by dehiscing prior to harvest. Data are presented in Table 2.

Table 1. Dry forage produced by several cool-season legumes. West Florida Experiment Station, Jay, Florida

	Pounds per acre		
Legumes	1967-68	1968-69	1969-70
Crimson clover:			
Auburn	5825	2766	2541
Autauga	5367	2994	4470
Chief	4519	3565	4570
Domestic	--	2611	5237
Early Reseeding	6810	3690	4733
Frontier	6422	3268	5228
Arrowleaf clover:			
Amclo	4295	4338	1801
Yuchi	3989	4186	1354
Meechee	2115	3999	1084
White clover:			
Ladino	--	--	1032
La. S-1	--	--	1421
Nolin's Improved	--	--	1628
Regal	--	--	825
Tillman	--	--	617
WFES #1	--	--	887
Lupine:			
Frost	--	--	5184

Table 2. Forage and seed yields of lupines. West Florida Experiment Station, Jay, Florida

	1969-70			
Variety	Height (in.)	Green Forage (lb/A)	Dry Forage (lb/A)	Clean Seed (lb/A)
Frost	25	10,875	1504	810
Rancher	18	7,986	1158	591
64-187	23	11,456	1699	1069

***

GEORGIA

Crownvetch Adaptation Trial at Tifton, Georgia

Homer D. Wells and Ian Forbes (Tifton)

Seedlings from 21 accessions of crownvetch, Coronilla varia L., were inoculated with Rhizobium sp. and grown in the greenhouse. They were transplanted to a spaced-plant nursery at Tifton in November 1965. The accessions included Emerald, Penngift, Georgia-1, and 18 experimental lines obtained from Paul R. Henson. Twenty-seven seedlings from each accession were planted in three replications in randomized blocks with plants on 3' x 5' centers. The trial was grown on well-drained Tifton loamy sand to which 2 tons of dolomitic lime and 600 lb of 0-10-20 fertilizer had been applied.

Rapid growth began in the spring of 1966. The plants within all accessions were highly variable for vigor, leaflet size, prostrateness or erectness, rate of rhizome spread, density of stems, number and density of leaves, and flowering date. The nursery was mowed to a 3-inch height on June 2, June 28, August 25, and October 31. A 36-plant sample yielded 10.8, 3.4, 3.4, and 2.0 lb of green matter on these dates, respectively, with dry matter contents of 29.5, 22.4, 22.1, and 19.3 percent. These results show that crownvetch produced more than half its forage by June 2.

In early June, Rhizoctonia solani and Fusarium sp. injured the crowns and rhizomes of some of the plants. By July 10, disease injury was severe throughout the nursery with many plants being killed entirely. At that time, Rhizoctonia solani and Sclerotium bataticola were isolated from diseased rhizomes and stems. These diseases severely injured and killed more of the plants in 1967. No highly disease-resistant plants were observed. Also, attempts to establish the 21 accessions by direct seeding in April 1966 in prepared seed beds and in Coastal bermudagrass sod failed because of damping-off by fungi. We concluded that crownvetch was poorly adapted to the sandy soils and climatic conditions of the Georgia Coastal Plain because of disease susceptibility.

<u>Publications</u>:

1. Forbes, Ian, Homer D. Wells, Robert E. Burns, James W. Dobson, and John R. Edwardson. 1969. Breeding and characteristics of Frost blue lupine. Proc. Assoc. Sou. Agr. Workers, Inc., 66th Annual Convention, p. 104-105.

2. Monson, W. G., R. S. Lowrey, and Ian Forbes, Jr. 1969. *In vivo* nylon bag vs. two-stage *in vitro* digestion: Comparison of two techniques for estimating dry-matter digestibility of forages. Agron. J. 61(4):587-589.

3. Wells, Homer D. and Durham K. Bell. 1969. Pathogenicity of fungi isolated from blue lupine (*Lupinus angustifolius* L.) seed to damaged and undamaged seed in axenic culture at two temperatures. (Abstr.) XI International Botanical Congress, p. 235.

4. Wells, Homer D. and D. K. Bell. 1969. Fungal pathogenicity to sound and mechanically damaged blue lupine seed in axenic culture at two temperatures. Plant Dis. Reptr. 53(10):774-776.

5. Forbes, Ian, H. D. Wells, J. R. Edwardson, R. E. Burns, and J. W. Dobson. 1970. Frost blue lupine, a winterhardy, disease resistant forage, bred at Coastal Plain. Ga. Agr. Res. 11(4): 12-13.

***

HAWAII

Low-mimosine Breeding of Leucaena Species

James L. Brewbaker (Honolulu)

Progress continues toward the development of high-yielding low-mimosine strains of *Leucaena leucocephala* ("koa haole" in Hawaii), one of the most important woody legumes of the tropics. Five strains have been outstanding in Hawaiian yield trials (1), and have performed very well in preliminary tests in southeast Asia. These are K6, K8, K28, K29, and K67 (P.I. numbers 281772, 263695, 281607, 281609, and 288005); seeds may be obtained from the University of Hawaii. Yields of these strains in Hawaii under continuous harvest averaged 42 tons green forage per acre per year, 250% times that (17 tons) of the shrubby "Hawaiian" type of koa haole found throughout the tropics. This 42-ton value represents 11 tons dry weight or 2½ tons of crude protein per acre per year.

The University of Hawaii collection now includes about 400 accessions, representing about 30 of the 51 reported species of the genus. Taxonomic studies lead us to consider only twelve of these species valid, and all tested species except *L. leucocephala* (2n = 104) have 52 or 56 chromosomes.

A concerted international effort is underway to lower mimosine content in *L. leucocephala*, its rate of progress necessarily dependent on very limited funds. Sources of low-mimosine germplasm include the Colombian strains earlier reported by Brewbaker and Hylin (2), and the diploid low-chromosome species like *L. pulverulenta* (Gonzalez, Brewbaker, and Hamill(3)), from which segregants with less than half the content of standard types (2% vs. 4.5% dry weight) have been obtained and are being propagated. Mutation breeding appears a major possibility, and these studies have been initiated in Hawaii and the Philippines.

Publications:

1. Brewbaker, J. L., D. L. Plucknett, and V. Gonzalez. 1970. Varietal variation and yield trials of *Leucaena leucocephala* in Hawaii. Hawaii Agr. Exp. Sta. Res. Rept. 187 (in press).

2. Brewbaker, J. L. and J. W. Hylin. 1965. Variations in mimosine content among Leucaena species and related Mimosaceae. Crop Sci. 5:348-349.

3. Gonzalez, V., J. L. Brewbaker, and D. E. Hamill. 1967. Leucaena cytogenetics in relation to the breeding of low mimosine lines. Crop Sci. 7:140-143.

***

IOWA

New Variety of Birdsfoot Trefoil Released

I. T. Carlson, W. F. Wedin, F. W. Schaller,
and C. D. Hutchcroft (Ames)

'Carroll' birdsfoot trefoil (formerly designated Iowa R-1) was released by the Iowa Agricultural Experiment Station in April 1970. It was named in honor of the late Dr. Carroll P. Wilsie who developed it.

Birdsfoot trefoil is already an important pasture legume in Iowa. This improved variety will add significantly to continued pasture development in this state and other areas of trefoil adaptation.

Carroll is a synthetic variety derived from two Russian introductions, P.I. 228151 (Kuban 44) and P.I. 258467 (Morshansk 528). First-generation seed was produced by intercrossing 34 second-cycle selections from crosses among 28 plants of the two introductions. Selection was practiced for vigor, winter hardiness, large seed size, and good seed production characteristics.

Carroll is a winter-hardy pasture type. It is less prostrate and slightly earlier in maturity and has larger seeds than Empire.

Carroll has been superior in forage yield, winter hardiness, and seedling vigor in tests conducted in Iowa, Illinois, Minnesota, and South Dakota. Average performance in two Iowa tests is shown in Table 1. It was particularly outstanding in vigor and forage yield in the year of establishment at Ames. Visual observations indicate that Carroll makes good recovery after cutting. It was superior to Dawn and Empire in persistence three years after establishment at Ames.

Second-generation seed (Syn-2) was planted in two fields in Minnesota in 1969 for the production of Foundation seed. Foundation seed will be used to produce Registered seed which, in turn, will be used to produce the Certified class of seed. According to the planned schedule, Certified seed will be available to farmers for forage production in late 1974 or 1975.

Table 1. Average performance of Carroll and three other varieties of birdsfoot trefoil in tests in Iowa, 1967-70.

Varieties	Seedling vigor[1/] Ames 1967	% stand Ames May 1970	Forage yield in tons of dry matter/A/year: Ames 1967-69	Beaconsfield (1968-1969): Hay stage	Beaconsfield (1968-1969): Pasture stage
Carroll	1.8	48	2.77	3.77	3.16
Dawn	3.2	34	2.66	3.80	3.17
Leo	1.6	54	2.65		
N.Y. Empire	4.0	28	2.47	3.30	2.96

1/ Rated from 1 to 5 on June 30, 1967 (72 days after planting); 1 = best, 5 = poorest.

***

Effects of Defoliation Frequency on Improved Birdsfoot Trefoil Varieties (Progress Report, 1968-1969)

W. F. Wedin (Ames)

A trefoil variety-management study, seeded in 1967, was harvested in 1968 and 1969. The primary objectives of the study are to:

1. Evaluate two large-seeded breeding selections with the variety Empire.

2. Evaluate the performance of Dawn birdsfoot trefoil, a University of Missouri and U.S. Department of Agriculture release.

Details of the study are given in the Clovers and Special Purpose Legumes Newsletter 3:19-20, 1969.

Following are data on the 2-year mean yields.

Birdsfoot Trefoil Varieties
Shelby-Grundy Experiment Farm--1968-1969

Mean Yields of Dry Matter in Tons Per Acre

Management1/	Empire	Russian2/ Large Seed R-1 Acc. #3019	Empire Large Seed Acc. #3020	Dawn	Avg.
Pasture	2.96	3.16	2.66	3.17	2.99
Hay	3.30	3.77	2.98	3.80	3.46
Avg.	3.13	3.47	2.82	3.48	3.22

1/ Harvest dates: Pasture, 1968: 6/6, 6/27, 7/24, 8/15, 9/18
1969: 6/16, 7/14, 8/12, 9/18
Hay, 1968: 6/13, 7/25, 9/9
1969: 6/16, 7/31, 9/18

2/ Released as Carroll by Iowa Agricultural Experiment Station, 1970.

After 2 years, no difference is shown in average yield of R-1 (now designated Carroll) and Dawn. Within years, R-1 outyielded Dawn in 1968, but results were reversed in 1969. Empire out-yielded the large-seeded Empire.

The hay management yielded more total dry matter over all varieties, this increase being approximately 0.5 ton per acre.

Yields are being taken again in 1970.

***

Grazing Management of Emerald Crownvetch
(Progress Report, 1968-1969)

W. F. Wedin and R. L. Vetter (Ames)

The grazing management study reported in the Clovers and Special Purpose Legumes Research Newsletter 3:20-22, 1969, details the establishment and first grazing year results. For purposes of clarification, the objectives of the study are repeated here.

1. To determine how Emerald crownvetch persists under either moderate or heavy grazing pressure.

2. To determine the performance of beef cattle grazed on crownvetch.

3. To determine animal output per acre in terms of carrying capacity and liveweight gain.

Yearling steers were used in both 1968 and 1969. The following table indicates the results for the two years.

Emerald Crownvetch Grazing Management Study
Western Iowa Experimental Farm--1968-1969 1/

Grazing pressure 2/	Average daily gain, lb.			Steer days per acre			Liveweight gain per acre		
	1968	1969	Avg.	1968	1969	Avg.	1968	1969	Avg.
Moderate	1.61	1.96	1.78	97	181	139	156	354	255
Heavy	1.48	1.70	1.60	134	230	182	198	394	296

1/ Grazing season: 1968, 6/18 to 9/24 (98 days)
1969, 5/22 to 9/22 (123 days)

2/ Heavy grazing pressure is defined as 25 to 50% more animals than on moderate grazing.

Salient points related to the 1969 season are (1) longer grazing season, (2) better animal performance than in 1968, (3) increased carrying capacity per acre, and (4) increased liveweight gain per acre. Whether these levels will hold in 1970 or not is questionable. Stands are as yet satisfactory, although some winterkilling of crownvetch was evident on north-facing slopes.

***

Fertilization and Management to Rejuvenate Established Birdsfoot Trefoil Stands (Progress Report, 1969)

W. F. Wedin and R. L. Vetter (Ames)

A detailed report of this study after 5 years of grazing was presented in Clovers and Special Purpose Legumes Newsletter 3:22-24, 1969.

Pastures in this study were grazed during an 8-year period (1956-63) and showed the value of birdsfoot trefoil-renovated pastures as compared to either unimproved or to grass pastures fertilized with nitrogen (N) and phosphorus (P). Beef production per acre on trefoil pastures declined from 1961 to 1963. Thus, at the time of modification from 1964, the following comparisons were provided for:

1. Yields of forage and animal performance on four pasture treatments.
   a) Unimproved
   b) Grass + N, P, K
   c) Birdsfoot trefoil (BFT) + P, K (8-year-old stand)
   d) Birdsfoot trefoil (BFT) + P, K (8-year-old stand) alternated with grass + N, P, K
2. Percentage BFT in c) and d) as they compare to the percentage obtained in 1961, 1962, and 1963.

The experiment will be continued in 1970. Thus, a summary of results obtained over the 6-year period (1964-1969) is presented in the following table.

Dry Matter Yields, Birdsfoot Trefoil Percentages in the Sward, Animal Performance, and Acre Output Data
Shelby-Grundy Experimental Farm, Beaconsfield, Iowa (1964-69)1/

	Unimproved	Grass + N,P,K	BFT + P,K	BFT + P,K (alternated with grass + N,P,K)2/3/
Dry matter yield, tons/A	1.63	2.75	3.02	3.02
% birdsfoot trefoil in sward	1	0	25	31
Avg. daily gain, lb	1.16	1.27	1.62	1.49
Steer days/A	66	182	209	184
Beef produced/A, lb	78	228	339	276

1/ Following initial adjustments in fertility applications, the applications from 1966 on were, annually: Unimproved--None; Grass + N, P, K--60+16+3 (N+P+K); BFT--0+24+48 (N+P+K).

2/ Pastures set up with approximately 75% of the acreage in BFT + P, K and 25% in grass + N, P, K.

3/ Yield and botanical composition data given for the birdsfoot trefoil pasture. Animal data are presented for the combination.

***

Grain Feeding on Birdsfoot Trefoil or Reed Canarygrass Pastures
(Preliminary Summary Report--Pasture Data Only, 1965-1969)

W. F. Wedin and R. L. Vetter (Ames)

Pasture-grain treatments of this study are presented in the following table.

Pasture-Grain Treatments
Shelby-Grundy Experimental Farm, Beaconsfield, Iowa

Treatment	Description
Pasture only:	
Birdsfoot trefoil (BFT)	Seeded Empire variety at 6 lb per acre, no companion crop, clipped three times during the seeding year.
Reed canarygrass (RCG)	Seeded common reed canarygrass, southern Minnesota grown seed of more than 80% germination, at rate of 10 lb per acre with oats companion crop of 1 bushel per acre.
Pasture + Grain:	
BFT + Grain	Seedings as above, during the grazing seasons, steers were fed grain (ground shelled corn) as follows: first 21-day period as pasture, no grain; second 21-day period, 5 lb per day; third 21-day period, 10 lb....to eventual full feed at 20 lb per day.
RCG + Grain	Seedings and grain feeding program as above.

Excellent stands of reed canarygrass were available for grazing in 1965. Unfortunately, the birdsfoot trefoil seedlings were not ideal because high winds caused damage to the small seedlings in absence of a companion crop in 1964.

All pastures were fertilized with phosphorus and potassium to assure optimum fertility. Reed canarygrass pastures received 120 pounds of nitrogen per acre annually in two 60-pound applications.

Three steers were grazed continuously on each pasture treatment for the entire grazing season. Additional steers were added or taken off when necessary to adjust grazing pressure. Reed canarygrass pastures were fenced into thirds. Where and when cattle numbers were not sufficient to handle the forage, up to one-third of the area was harvested. Steer days for the pasture were credited on the basis of dry matter removed x 50 percent estimated TDN ÷ 12, a steer day being equivalent to 12 pounds of TDN.

Iodized salt and water were provided free choice. The ground shelled corn was hand-fed in open feed bunks once daily to the steers on the pastures with grain treatments.

The steers without grain feeding were removed from pasture and brought into the feedlot about September 25 each year. Steers receiving grain on pasture were allowed to graze three weeks more. The tester steers (steers that were grazed continuously throughout the season) from each pasture replicate for a given pasture treatment were allotted together, giving nine steers per feedlot pen. In addition, grazer steers (steers that were added or taken off to adjust grazing pressure) were used if they had been on the same pasture treatment for the last half of the grazing period. A maximum of 15 steers per feedlot pen was allowed. For some treatments within years, a total of 12 steers was all that could be used because of the limitation set for use of grazer steers.

Summary of Results Over 5 Years (1965-1969)

	Pasture Treatment			
	No Grain		With Grain	
	Birdsfoot trefoil	Reed Canarygrass	Birdsfoot trefoil	Reed Canarygrass
Length of grazing season	130	147	156	168
Average daily gain, lb.	1.23	1.38	2.10	1.74
Steer days/acre	218	261	304	469
Beef produced/acre, lb.	268	360	638	816
Stocking rate (no steers carried per acre for length of season specified)	1.68	1.78	1.95	2.79

A preliminary summary on data from 5 years of grazing is given. The data indicate that reed canarygrass pastures produced more total beef per acre than birdsfoot trefoil. Length of grazing season was from 13 to 17 days longer for reed canarygrass than for birdsfoot trefoil. Reed canarygrass is usually available for grazing by May 1 in southern Iowa.

The carrying capacity of Reed canarygrass pastures was greater (1.78 steers per season/A) than for birdsfoot trefoil pastures (1.68). When fed grain on pasture, the carrying capacity for Reed canarygrass pastures was 2.79 steers/A per season (168 days).

The average daily gain for steers on birdsfoot trefoil alone were disappointing. In previous work (8-year study), average daily gains of 1.66 lb were obtained on birdsfoot trefoil-grass pastures. When grain was fed, the average daily gain values for birdsfoot trefoil were

increased .87 lb, or 71%. However, grain fed on [illegible] ryegrass increased gains only .36 lb, or 2%.

A complete summary of this grazing study will be [illegible]ed.

Publications:

1. Buxton, D. R. and W. F. Wedin. 1970. Establishment of perennial forages. I. Subsequent yields. Agron. J. 62:93-97.

2. Buxton, D. R. and W. F. Wedin. 1970. Establishment of perennial forages. II. Subsequent root development. Agron. J. 62:97-100.

3. Greub, L. J. and W. F. Wedin. Leaf area, dry matter accumulation, and carbohydrate reserves of alfalfa (Medicago sativa L.) and birdsfoot trefoil (Lotus corniculatus L.) under a three-cut management. Submitted for publication to Crop Science.

4. Wedin, W. F., and R. L. Vetter. Pastures for beef production in the western corn belt. XIth International Grassland Congr., Proc., Brisbane, Australia. (In press)

* * *

MARYLAND

Robert C. Leffel (Beltsville)

Paul R. Henson's Retirement

Mr. Paul R. Henson, Research Leader for Special Purpose Legumes Investigations, retired from the Federal Service June 30, 1970. Mr. Henson began his carreer with the Forage and Range Research Branch in 1930 as an Assistant Agronomist in Alfalfa Investigations at Stoneville, Mississippi. Subsequently, he conducted research on grass breeding and pasture management at Beltsville, Maryland, from 1938 to 1943, and on soybean improvement at Stoneville, Mississippi, from 1943 to 1948. He served as Research Leader for Special Purpose Legumes Investigations from 1948 until his retirement. Mr. Henson has made many significant contributions to forage research and has assumed a leading role in furthering the use of special legume crops for forage and soil conservation. Acting Leader for Special Purpose Legumes is Dr. R. C. Leffel.

Trifolium Research Work Conference

A *Trifolium* Research Work Conference was held at Clemson, South Carolina, March 17-18, 1970. Thirty-two research scientists were in attendance, including two from Canada. Emphasis was placed on taxonomy and interspecific hybridization of *Trifolium* species. A copy of the report of the *Trifolium* Work Conference will be available upon request.

***

MICHIGAN

Lupine Research in Northern Michigan

H. L. Kohls and F. C. Elliott (East Lansing)

Lupine breeding of both Lupinus angustifolius and L. albus has been in progress here for several years. A brief report of the work was made in 1968[1]. Additional information is given in the present report.

Table 1 lists blue lupine varieties with their grain yields and percent protein for the 1969 season and the feed efficiency[2], as measured by voles, for these varieties in 1968. The 1969 feed efficiency figures are not yet available. The yields range from 1148 to 798 pounds per acre, a difference of 350 pounds. All yields are low considering the apparently good growing season. Irrigation was available but was never necessary. The plants were vigorous growing and appeared very healthy. P.I. 237721 yielded 864 pounds in 1969 and averaged 1482 pounds in 1961 and 1962[1] at Lake City; 1256 and 1416 for similar varieties at Chatham in 1967. We have no explanation of why the relatively low yields in 1969.

The percent protein varies by four percentage points--27.13 to 31.13. But the feed efficiency ranged considerably--15.7 to 29.2. The low feed efficiency may possibly be explained by the varieties being low but not alkaloid free. The low efficiency of 15.7 and 19.8 may be due to too high alkaloid content for good vole growth.

The white lupines, as shown in table 2, yielded high 2,078 to 2,491 pounds per acre and were grown adjacent to the blue lupines reported in table 1. White lupines, apparently, were better adapted to the environment of that particular field than were the blue lupines.

The protein content was good and ranged from 31.31 to 35.94 percent. The feed efficiency was very good on several varieties but poor on some of the others. The variety with a 17.4 feed efficiency was known to have a higher alkaloid content than the other varieties.

1/ Newsletter, Vol 2, 1968, p. 19.

2/ $$\text{Feed efficiency} = \frac{\text{(Weight of animal gain)}}{\text{Weight of feed consumed}} \times 100$$

Two lots of grain were fed to dairy calves and young pigs. The two were blue lupine MSU-101 and white lupine MSU-5. Both varieties gave about the same results when fed to livestock. The calves on lupines gained in weight very satisfactorily but were significantly below (about 30 percent) the calves that were given soybean meal, as reported verbally by the Dairy Department. But the animal husbandry people reported the small pigs did very poorly on lupines and had to be taken off. It is not known at present why pigs reacted in this way.

Work is underway to develop very low alkaloid or alkaloid-free varieties. Some of these look very promising and are being increased for further feeding trials. White lupines as a cash grain crop to alternate with potatoes, particularly where irrigation is available, looks promising for parts of Michigan.

Lorox at 3/4 pound plus Lasso at 1 1/2 pounds per acre gave satisfactory control of weeds when used as a preemergence spray, and cultivation was not necessary.

Table 1. Yields in pounds per acre, percent protein, and feed efficiency of blue lupines grown in Montcalm County.

Variety	1969 Yield	1969 Percent Protein	1968 Percent Feed Efficiency
MSU-101	826	30.25	22.4
MSU-102	1148	30.30	25.0
MSU-103	924	30.31	--
Borre	964	31.31	23.0
P.I. 237721	894	30.25	24.2
P.I. 237721 X Borre	864	29.38	15.7
P.I. 237721 X S-13 blue	798	30.06	19.8
MSU-104	930	28.38	23.1
P.I. 237721 X S-13 sel plot 27	890	29.56	25.0
MSU-105	924	29.69	26.1
Rancher	925	27.13	29.2
Control (casein 7%)			27.5

Table 2. Yields in pounds per acre, percent protein, and feed efficiency of white lupines grown in Montcalm County.

Variety	1969 Yield	1969 Percent Protein	1968 Percent Feed Efficiency
Blanca	2359	33.81	26.8
MSU-1	2341	32.81	27.1
Blanca (5 very high yielding selections)	2235	33.06	--
Composite (7 plants)	2305	33.56	20.3
Composite (8 plants)	2232	31.31	22.7
MSU-2	2364	33.81	26.1
MSU-5	2263	34.56	25.0
Gela	2491	33.81	26.2
MSU-3	2372	31.63	27.5
Gela X U.S.S.R.-305	2368	32.88	22.0
Gela X U.S.S.R.-305 (5 plants tan seed)	2472	32.25	17.6
MSU-4	2368	32.56	27.4
P.I. 243335 X U.S.S.R.-305	2306	32.81	25.3
U.S.S.R.-305 (selection)	2078	35.94	---
Control (casein 7%)			27.5

MISSISSIPPI

Annual Clover Investigations

William E. Knight (State College)

Genetic studies have been completed on ten leaf and flower characteristics of crimson clover. Selection and inheritance studies are in progress for various flower colors, seed color variations, and plant coloration. As more marker genes are accumulated in crimson clover, specific chromosomes and chromosomal regions can be identified. Some of these mutants will be of interest morphologically and of possible value as physiological indexes; e.g., sticky leaf.

Selection is in progress for crimson clover inbred lines possessing high-temperature dormancy and for arrowleaf clover lines that do not have this characteristic. Lines of crimson clover with high and low levels of high-temperature dormancy have been selected for future inheritance studies. The arrowleaf lines are in the second cycle of selection for low levels of high-temperature dormancy.

Polycross testing was continued on additional inbred lines in continuing effort to find superior genotypes. Preliminary evaluation of inbred lines and polycrosses utilizing the Van Soest technique indicated differences between inbred lines and polycrosses in nutritive value. Although crimson clover is generally considered a highly nutritious forage, these results suggest that improvement of quality by breeding is possible in this species.

Six single crosses between 12 S_1 crimson clover lines were made and were evaluated in the field in 1970. Single crosses will be matched by maturity and other agronomic characteristics for the production of double-cross hybrid seed. Adequate seed will be produced for regional evaluation of double crosses in 1971.

Cooperative work has been initiated with the Biochemistry Department on the chemical nature of floral pigments in crimson clover and their mode of inheritance.

Management studies with annual clovers grown in a grass sod suggest the utilization of winter-annual clovers to supply part of the nitrogen requirement of summer-growing grasses. In addition to a reduction in mineral nitrate requirement, other benefits would be an extended grazing season, increased total forage production, increased forage quality, and better utilization of land resources. Investigations of reseeding and forage production of crimson and arrowleaf clover in a bermudagrass sod indicate that crimson clover produces more fall and winter growth than arrowleaf and is less sensitive to defoliation than arrowleaf. Crimson clover has consistently produced earlier growth and competes less with the summer grass than the other clover species tested.

Arrowleaf clover grows into the summer at about the same time as white clover. Most of the yield comparisons reported in the literature have been between arrowleaf and crimson clover. The latter species is in full bloom by late April when the arrowleaf varieties are at their peak of vegetative growth. It seemed desirable to have data comparing the arrowleaf varieties with other Trifolium species that grow into the summer. Therefore, a test was planned to compare the winter annuals, crimson and arrowleaf, with white and red clover, with the latter two species treated as annuals. Regal white clover and Orbit red clover were included with two crimson and four arrowleaf clovers. Forage was clipped from whole plots when about 10 inches of growth was present (Table 1). Better forage distribution was produced throughout the summer by white and red clover. Yields of the winter annual clovers were reduced in the April and May harvest by a severe spring drought. In spite of unfavorable spring conditions, crimson clover produced the earliest forage.

Table 1. Forage yields of annual clovers compared with selected varieties of red and white clovers.

Clover Variety*		Date of harvest and forage yield in lb DM/A							
		1-25	** 3-20	4-20	5-31	6-21	7-19	8-29	Seasons Total
Amclo	A	--	124	1140	100	--	--	--	1364
Meechee	A	--	131	1140	280	--	--	--	1551
Yuchi	A	--	189	1380	260	--	--	--	1829
P.I. 279948	A	--	--	520	180	--	--	--	700
Chief	C	104	713	3060	--	--	--	--	3877
Frontier	C	284	1252	1480	--	--	--	--	3016
Orbit	R	--	475	2920	3080	1800	160	460	8895
Regal	W	--	163	1520	1740	1360	980	980	6743
LSD .05		--	160	560	220	720	100	380	660
C.V. %		--	28.7	29.3	18.7	30.9	12.1	34.7	18.5

* A = Arrowleaf; C = Crimson; R = Red; W = White.

** Rainfall for January - April, inclusive, was 10.61 inches below the 74-year average for this period.

Publications:

1. Knight, W. E. 1969. Inheritance of multifoliolate leaves, glabrous leaves and petiolulate leaflet attachment in crimson clover, *Trifolium incarnatum* L. Crop Sci. 9:232-235.

2. Knight, W. E., V. E. Ahlrich, and M. Byrd. 1969. Registration of Meechee arrowleaf clover. Crop Sci. 9:393.

3. Knight, W. E. 1969. Application of genetic incompatibilities to plant breeding -- Leguminoseae. Rept. 26th Sou. Pasture and Forage Crop Improvement Conference, pp. 36-39.

4. Knight, W. E. Productivity of crimson and arrowleaf clover grown in a Coastal bermudagrass sod. Agron. J. 62:________. (1970)

***

MONTANA

Forage Legume Research Results

A. E. Carleton, W. J. Knipe and R. L. Haaland (Bozeman)

Sainfoin

Forage trials

Sainfoin varieties and breeding lines are currently being evaluated for hay yield at several locations in Montana. Data from the Bozeman location are presented in this report. Eski sainfoin was the highest yielding entry in the year of seeding with over 4 T/A at 12% moisture yield (Table 1). Eski and a white flower selection from Eski produced over 8 T/A in the first harvest year. Ladak 65 alfalfa had a yield of 7.5 T/A. Table 2 gives the hay yields of eight sainfoin lines and varieties grown at Bozeman. Eski and two lines from Romanian (I-CA6 and 105-59) produced the most hay both years. Under a two cutting regime it appears that Eski sainfoin is the best adapted varieties to the Bozeman location.

Table 1. Hay yields of six sainfoin entries and Ladak 65 alfalfa grown at Bozeman, Montana, in 1968 and 1969.

Entry	1968[1] T/A	1969 Total Season[2] T/A
White PX (From Eski)	2.46*	8.17
Eski	4.29	8.07
Canadian	3.22*	7.89
Ladak 65	3.41*	7.54
Persian	2.79*	7.52
Regrowth PX (Non-Eski)	2.31*	6.56*
Augusta	1.92*	6.16*
LSD .05	.67 T/A	1.18 T/A
C.V.	15.5%	10.7%

[1] Trial was seeded in 1968.
[2] Totals of two harvests.
* Means significantly different from Eski at .05 level of probability.

Table 2. Hay yields of eight sainfoin lines grown at Bozeman in 1968 and 1969.

Entry	1968[1/] T/A	1969 Total Season[2/] T/A
I-CA6 (Romanian)	4.19	8.71
105-59 (Romanian)	3.84	8.37
Eski	3.39	7.99
Persian	2.57*	6.65*
Regrowth PX (Non-Eski)	2.48*	6.50*
Vica	3.14	5.71*
M-1139	2.90	5.37*
Poland	1.50	4.13*
LSD .05	.83 T/A	1.20 T/A
C.V.	18.9%	12.2%

[1/] Trial was seeded in 1968.
[2/] Totals of two harvests.
* Means significantly different from Eski at .05 level of probability.

Self-fertility

According to literature published in Europe, sainfoin is highly self-sterile. At Bozeman, Montana, sainfoin is relatively self-fertile. However, to obtain a good seed set upon selfing, bees must be used for pollinating purposes.

During the summer of 1969, two clones of sainfoin were subjected to open pollination, selfing and crossing with bees and selfing by hand. Selfed progeny of the two clones were also included in the study.

Flowers were hand pollinated by brushing across the anthers and stigma with a key. This action should have placed self-pollen on the stigma. This procedure was repeated daily for two weeks and the plants were isolated in 2' x 2' screen-wire cages before and after the pollinations were made.

The selfs and two clone crosses were made in wire cages. A hive of honey bees was placed in each cage when the plants began to bloom. The open pollinated treatments were made close to other sainfoin plants and relied on native pollinators. Percentage fertility was calculated as the number of seeds per number of flowers tripped.

The results of this study indicated that these two clones of sainfoin were highly self-fertile. The hand technique was not as effective as selfing with bees (Table 3).

Table 3. Comparison of pollination techniques in two clones of sainfoin.

Treatments	Mean Fertility % W4	U13	Avg.[1/]	Environment[2/]
S_0 Open Pollinated	57.90	39.40	48.65 a	Field
S_1 Open Pollinated	51.50	40.40	45.95 a	Field
Selfed with bees	31.05	27.05	29.05 b	Enclosure
Crossed with bees	32.62	17.63	25.12 b	Enclosure
S_0 Selfed by hand	8.26	5.18	6.72 c	Enclosure
S_1 Selfed by hand	2.46	2.27	2.36 c	Enclosure
C.V. = 25.54%				

[1/]Means followed by the same letter are not significantly different at P = .05.

[2/]W_4 was selfed and crossed with bees in plastic bubbles. U_{13} was selfed and crossed with bees in 5' x 10' screen cages.

Additional work is needed to find an effective means of self-pollination by hand. In order to determine this, one needs to know what the bee is doing that we fail to do in hand pollination techniques.

In another study, eight clones of Eski were used in a series of selfs and crosses. Two selfs were made under plastic bubbles, four under wire cages and one in a space-isolated backyard. Eight crosses were made under the bubbles, two under wire cages, seven in isolated backyard plots and one in a field plot. All crosses were unemasculated. A hive of honey bees was placed in each bubble and cage when the plants began to bloom. Crosses made in backyard and field plots relied on indigenous pollinators so it was impossible to insure an adequate supply of pollinators.

Ten heads were randomly gathered within each treatment to estimate the percentage fertility. Percentage fertility was calculated by the number of seeds per number of flowers.

The mean fertilities of all selfs and crosses was not significantly different and was 23.01 and 16.08 percent, respectively (Table 4). Differences were observed between clones and pollinating environments but in no case did the plants set significantly fewer seeds with selfing than with crossing. The differences between pollinating environments could

Table 4. Percent self- and cross-fertility in eight clones of sainfoin.[1/]

Treatment[2/]	% Fertility	Pollinating Environment
U_7 selfed	37.60 a	Screen Cage
U_7xT_9	26.68 bcde	Screen Cage
U_7xU_{13}	17.99 fghi	Backyard Plot
W_4 selfed	31.05 abc	Plastic Bubble
W_4xW_1	32.62 ab	Plastic Bubble
W_4xW_3 & W_1	32.76 ab	Backyard Plot
U_{13} selfed	27.05 abcd	Screen Cage
U_{13} OP	23.25 bcdef	Open Field
$U_{13}xU_7$	17.63 fghi	Backyard Plot
W_3xW_4 & W_3	22.88 cedf	Backyard Plot
W_3xT_9	21.75 defg	Plastic Bubble
W_3xT_{10}	18.05 efghi	Plastic Bubble
W_1 selfed	7.84 jk	Plastic Bubble
W_1xW_4	11.64 hijk	Plastic Bubble
W_1xW_4 & W_3	9.68 ijk	Backyard Plot
W_1xT_{10}	6.77 jk	Plastic Bubble
T_9 selfed	20.99 defg	Screen Cage
T_9xU_7	6.76 jk	Screen Cage
T_9xT_{10}	5.20 jk	Backyard Plot
T_9xW_3	4.84 k	Plastic Bubble
T_{10} selfed	13.68 ghij	Screen Cage
$T_{10}xW_1$	13.66 ghij	Plastic Bubble
$T_{10}xW_3$	19.63 defgh	Plastic Bubble
$T_{10}xT_9$	4.43 k	Backyard Plot
H_1 selfed	26.83 bcd	Backyard Plot

[1/]Each value is the mean fertility of ten heads. Means followed by the same letter are not significantly different at P = .05.

[2/]W_3 was not selfed in this study. H_1 was not crossed in this study.

have been due to differential bee activity. This was particularly evident in the backyard plot crosses involving T_9 x T_{10} and T_{10} x T_9 where the bee activity was observed to be poor.

All clones tested were highly self-fertile.

Breeding

The major effort in sainfoin breeding is selection for regrowth. Seventeen plant introductions selected for regrowth have been bulked and are currently under test at several locations as a multi-cut hay and/or pasture-type sainfoin. Mother plants and their progeny from 16 of these lines have been evaluated for two years. The average yields of the 16 progeny lines and Eski are given in table 5. There are several lines with excellent recovery and it appears that a superior regrowth variety can be made by selection between, and possibly within, lines.

Phenotypic selection of spaced mother plants for forage yield was not effective (Table 6). Progeny from phenotypically selected clones were not superior to the average progeny from all mother plants. The performance of spaced mother plants was not a good indicator of progeny performance even in a relatively unselected crop such as sainfoin. Some form of progeny trial appears necessary to make genetic gain under selection. We are currently selecting from open-pollinated nurseries.

Cicer milkvetch

Germination, scarification and seedling vigor

Cicer milkvetch germinated best on water saturated blotter paper at alternating 15-25C temperatures for 14 days in the dark. Higher or lower temperatures lowered the germination percent. The alternating temperature of 15C for 12 hours and 25C for 12 hours gave the highest germinations.

Cicer seed was scarified with several different machines. It requires harsher scarification than alfalfa (Table 7). Germination of scarified seed decreases with storage even if only for one year. (Table 8). Care must be taken not to over scarify cicer. High laboratory germinations are not indicative of good field emergence (Table 9). Cicer seed severely scarified with an 88% laboratory germination had only 4% field emergence.

Speed of emergence and percent emergence of cicer was compared to several legumes at Bozeman and Bridger, Montana, in 1969 (Table 10). Seedling emergence and growth of cicer is slower than that of alfalfa and sainfoin but about equal to trefoil and red clover.

Table 5. Mean wet forage yields[1/] of 16 regrowth lines and Eski sainfoin grown at Bozeman in 1968 and 1969.

Entry & PI No	1968[2/] 2nd cutting	1969 1st	1969 2nd	1969 3rd	Total
223,389	5.5	14.0	7.9*	6.7*	28.6
227,373	5.2	12.5*	8.1*	6.7*	27.3
228,352	5.4	12.1*	8.0*	7.1*	27.2
239,958	5.7	13.6	7.7*	5.8*	27.1
243,227	5.5	14.0	7.8*	5.2*	27.0
229,612	5.4	12.7*	7.9*	5.8*	26.4
239,960	5.6	11.6*	8.0*	6.4*	26.0
243,226	5.2	12.8*	7.4*	5.4*	25.6
250,024	5.1	11.5*	7.7*	6.0*	25.2
228,402	5.6	11.8*	7.4*	6.0*	25.2
236,486	5.1	12.1*	6.4*	5.5*	24.0
236,957	5.2	11.1*	7.1*	5.7*	23.9
239,959	5.5	11.1*	7.1*	5.5*	23.7
Eski	5.1	15.3	4.7	3.0	23.0
228,289	4.8	10.2*	7.1*	5.2*	22.5
212,241	4.6	11.2*	6.4*	4.8*	22.4
227,038	5.3	10.3*	6.8*	4.9*	22.0
LSD .05	---	1.9 lbs	.8 lbs	1.2	----
C.V.	---	48.8 %	36.0 %	69.1 %	----

1/ Yield in pounds/plant.
2/ Regrowth on August 27 after all plants were clipped on July 23 in the year of seeding.
* Means significantly different from Eski at .05 level of probability.

Table 6. Effectiveness of phenotypic selection for forage yield among spaced sainfoin mother plants.

Original population	Harvest	$\overline{X}$ of selected progeny	$\overline{X}$ of all progeny
Eski	1st	1.78	1.68
	2nd	.79	.88
	Total	2.57	2.61

Table 7. The effect of the Wes Gro Process Brand Polisher on the germination of cicer milkvetch seed.[1/]

Scarification treatment	$\bar{X}$ germination %
Check (unscarified)	28.0g
Alfalfa setting	36.2f
3 times tighter than alfalfa setting	36.5f
5 times tighter than alfalfa setting (1 run)	44.0e
6 times tighter than alfalfa setting (feed of 1500 lb/hr)	46.0e
6 times tighter than alfalfa setting (feed of 180 lb/hr)	56.0d
5 times tighter than alfalfa setting (2 runs)	68.0c
5 times tighter than alfalfa setting (3 runs)	78.0b
5 times tighter than alfalfa setting (4 runs)	84.0a

[1/]Means followed by the same letter are not significantly different at the .05 level of probability (Duncans Multiple Range Test).

Table 8. The effect of scarification and storage of scarified seed on laboratory germination.

Treatment	% germination[1/] 1968	1969
Non-scarified	28.0	20.2
Alfalfa setting	36.2	12.8
5 times tighter than alfalfa setting	45.0	27.2
5 times tighter than alfalfa setting and feed of 180 lbs/hr	56.0	43.5
5 times tighter than alfalfa setting (2 runs)	68.0	29.0
5 times tighter than alfalfa setting (4 runs)	84.0	53.5

[1/]Hard seed not included.

Table 9. The effect of seed scarification on field emergence, % stand and forage yields of cicer milkvetch.[1/]

Treatments	Lab germ + hard seeds	Seeding date PLS/sq meter[2/]	% emer of PLS	% stand spring 1969[3/]	Seedling year T/A[4/]	2nd year T/A[5/]
Cicer non-scarified	20 + 69	312	12cd	35	1.54b	4.18bc
Cicer two times thru	57 + 15	312	25bc	52	1.89ab	5.22b
Cicer two times thru & inoc.	57 + 15	312	27b	56	2.22a	5.04b
Cicer four times thru	79 + 1	312	20bc	46	1.77ab	4.97b
Cicer four times thru & inoc.	79 + 1	312	22bc	48	1.83ab	4.75b
Cicer eight times thru	88 + 0	312	4d	16	.85c	3.48c
Alfalfa - Ladak 65	86 + 4	372	47a	78	1.86ab	6.76a
Alfalfa - Ranger	---	372	23bc	56	1.90ab	6.48a
Alfalfa - Vernal	79 + 13	372	26b	65	1.98ab	6.53a
Sainfoin - Eski	86 + 4	163	56a	65	1.71ab	4.26b

1/Mean followed by the same letters are not significantly different at the .05 level.
2/The mean number of germinated seed + hard seeds x purity of the sample.
3/% stand determined as the area occupied within 3-foot lengths of three rows in each plot.
4/Hay yield of one cutting in tons per acre at 12% moisture in 1968.
5/Hay yield of three cuttings in tons per acre at 12% moisture in 1969.

Table 10. Speed of emergence and % emergence of several legumes and scarified cicer seed at Bozeman and Bridger, Montana, in 1969.[1/]

Legume species and treatment	Emerg. at Bozeman		Emerg. at Bridger	
	$\bar{X}$ speed	%	$\bar{X}$ speed	%
Eski Sainfoin	24.2 a	38.3 a	37.8 a	69.2 a
Ladak 65 Alfalfa	24.2 a	31.1 b	40.3 a	62.2 b
Kenland red clover	6.7 b	12.1 c	14.3 c	28.8 de
Leo Birdsfoot trefoil	5.9 bc	9.4 cd	23.1 b	46.9 c
Cicer, 5 times tighter than alfalfa setting (2 runs)	3.2 bc	9.0 de	10.4 d	32.6 c
Cicer, 5 times tighter than alfalfa setting 180 lb/hr feed	3.1 bc	8.3 de	9.8 d	31.6 d
Cicer, 5 times tighter than alfalfa setting (1 run)	2.6 bc	8.0 de	9.3 d	30.2 d
Cicer, Montana Syn 1	2.5 bc	5.5 de	8.1 de	21.1 f
Cicer, Alfalfa setting	2.5 bc	6.9 de	8.1 de	25.8 ef
Cicer, non-scarified	2.2 bc	6.2 de	7.0 de	23.9 f
Cicer, 5 times tighter than alfalfa setting (4 runs)	1.6 c	4.2 e	5.4 e	15.8 g

[1/]Means followed by same letters are not significantly different at the .05 level of probability.

Publications:

1. Carleton, A. E., C. S. Cooper, C. W. Roath and J. L. Krall. 1968. Evaluation of sainfoin for irrigated hay in Montana. Sainfoin Symposium, Agr. Exp. Bul.

2. Carleton, A. E. and L. E. Wiesner, 1968. Production of sainfoin seed. Sainfoin Symposium, Agr. Exp. Bul.

3. Carleton, A. E. 1968. The sainfoin breeding program in Montana. Sainfoin Symposium, Agr. Exp. Bul.

4. Chapman, Stephen R. and Margaret Yuan. 1968. Cytological and morphological variation in breeding stocks of Onobrychis. A preliminary report. Sainfoin Symposium, Agr. Exp. Bul.

5. Cooper, C. S., C. W. Roath, J. L. Krall and C. W. Crowell. 1968. Preliminary evaluation of sainfoin (Onobrychis viciaefolia Scop.) for irrigated pasture. Sainfoin Symposium, Agr. Exp. Bul.

6. Cooper, C. S., A. E. Carleton, R. F. Eslick and R. H. Delaney. 1968. Evaluation of sainfoin (Onobrychis viciaefolia Scop.) for winter-hardiness. Sainfoin Symposium, Agr. Exp. Bul.

7. Dubbs, A. L. 1968. The performance of sainfoin and sainfoin-grass mixtures on dryland in Central Montana. Sainfoin Symposium, Agr. Exp. Bul.

8. Dubbs, A. L. 1968. Sainfoin as a honey crop. Sainfoin Symposium, Agr. Exp. Bul.

9. Krall, J. L. 1968. Preliminary report on grazing irrigated sainfoin with yearling steers. Sainfoin Symposium, Agr. Exp. Bul.

10. Mathre, Don. 1968. Disease in sainfoin. Sainfoin Symposium, Agr. Exp. Bul.

11. Newman, C. W. 1968. Sainfoin and alfalfa hay in swine diets. Sainfoin Symposium, Agr. Exp. Bul.

12. Roath, C. W. 1968. Sainfoin for dryland hay in Western Montana. Sainfoin Symposium, Agr. Exp. Bul.

13. Roath, C. W. and D. R. Graham. 1968. Response of sainfoin to phosphorus. Sainfoin Symposium, Agr. Exp. Bul.

14. Shaw, A. L. 1968. The certification program for sainfoin in Montana. Sainfoin Symposium, Agr. Exp. Bul.

15. Sims, J. R., M. K. Muir and A. E. Carleton. 1968. Evidence of ineffective rizobia and its relation to the nitrogen nutrition of sainfoin. Sainfoin Symposium, Agr. Exp. Bul.

16. Stewart, V. R. 1968. Chemical weed control in sainfoin. Sainfoin Symposium, Agr. Exp. Bul.

17. Ryerson, D. E. and J. E. Taylor. 1968. Sainfoin in dryland range interseedings in Montana. Sainfoin Symposium, Agr. Exp. Bul.

18. Wallace, L. E. ARS, USDA. 1968. Current and potential insect problems of sainfoin in America. Sainfoin Symposium, Agr. Exp. Bul.

19. Wiesner, L. E., A. E. Carleton and C. S. Cooper. 1968. Factors affecting sainfoin seed germination and emergence. Sainfoin Symposium, Agr. Exp. Bul.

***

NEW YORK

Crownvetch Seed Production

(Excerpt from 1969 Annual Report)
C. L. Williams (Big Flats)

One of the greatest problems in producing seed of crownvetch (*Coronilla varia*) in the Northeast is that of fall plant regrowth. This is caused primarily by cool temperatures and rainfall. If these conditions persist during the month of August, lush green vegetation often builds up a layer 6 to 10 inches in depth above the seed pods. This keeps the pods shaded and moist; therefore the seed cannot mature normally. Also, this causes severe problems in harvesting. Most all crownvetch seed within this region is direct combined. The lush green regrowth is above the seed pods; therefore, of necessity, it must pass through the combine. This not only slows down the process of harvesting, but causes a considerable increase in moisture content of the seed and its accompanying inert material.

Preliminary trials indicated the problem of plant regrowth could be controlled by the use of chemicals which act as desiccants and/or defoliants. In order that trials might be conducted on a field-scale basis, a new planting of crownvetch was made in the spring of 1967. The rows were spaced 126 inches apart to facilitate spraying and harvesting.

The first chemicals were applied August 22, 1968. Weather conditions were such that regrowth was becoming a serious problem. Results of the tests were very promising. Regrowth could be controlled without causing a significant decrease in seed yield or germination.

The study was continued in 1969. Additional chemicals and rates of application were included. Again, as in 1968, the conditions were ideal for plant regrowth. It rained during 11 of the first 18 days of August. Temperatures averaged 2 degrees below normal, with the daily minimum temperatures dropping as low as 40 F. The chemicals were applied August 22, 1969. Date of harvest was September 5.

Table 1 gives complete details as to the chemicals, their rates of application, and the effects they had on the plants and seed. An explanation of each column in the table follows:

(1) Row number in field. Rows 1 through 15 were located on the Plant Materials Center. The symbols H1 and H2 designate the check and treated areas, respectively, of a seed production field located off of the Center.

(2) Trade name of chemicals.

(3) Rate of application. Solvent 52 is a petroleum product and is applied without a carrier. Water (50 gal/A) was used as a carrier for the other chemicals.

(4) Percent burn of stems and leaves caused by chemical. Figures are based on visual observations made 4 days following application.

(5) Percent moisture of stems and leaves. Samples were taken at time of harvest, immediately after material had passed through combine.

(6) Percent moisture of seed and its accompanying inert material. Samples taken at time of harvest.

(7) Test weight of combine-run seed after drying.

(8) Test weight of clean seed.

(9) Yield (lb/A clean seed). The yields were poor; however, they serve as a means for comparison in this study.

(10) Germination. Includes both readily germinable and hard seed.

The immediate visual effects of the two paraquat treatments were outstanding; therefore the decision was made to treat a seed production field located off the Plant Materials Center. The rate of application of paraquat was reduced to 1 pint/A applied in 50 gallons of water. The field was treated August 28 and was harvested September 1, 1969. The samples from the non-treated and treated areas within the field are designated in the table as row numbers H1 and H2. This treatment did a remarkable job of controlling plant regrowth and reducing moisture content of plant and seed without decreasing seed yields or germination. Also, this treatment allowed the ground speed of the combine to be increased considerably. A direct comparison cannot be made between the results obtained from this field and the results from treated rows of crownvetch on the Plant Materials Center because of a difference in site and climatic conditions.

All of the chemical treatments were beneficial to some degree. However, the diquat and paraquat treatments were the most effective in meeting the objectives of this study. Further study is needed to determine the most effective rates and time of application.

Crownvetch seed production fields often become contaminated with weeds and grasses. Quackgrass seems to be the worst offender. It invades the fields very readily, and the seeds are difficult to separate from the crownvetch. Many chemicals have been tested during the past few years. One is outstanding: Hyvar X-WS applied during the first two

Table 1 - Results of chemicals applied to crownvetch plots prior to harvest

Row	Chemicals	Rate of Application (per acre)	Percent Burn (Stems & Leaves)	Percent Moisture (Time of Harvest) Stems & Leaves	Percent Moisture (Time of Harvest) Seed	Test Weight Combine-Run Seed	Test Weight Clean Seed	Yield (lbs/A)	Germination
1	Check	-	-	73	57	13	62	40	70
15	Diquat	1 pt.	80	57	34	22	63	42	70
3	Diquat	2 qt.	95	26	27	13	63	38	69
12	Dow Premerge	1.5 pt.	10	72	60	12	62	35	70
8	Dow Premerge	1.5 qt.	25	71	50	22	62	35	70
4	Endothal	1 qt.	None	71	66	11	63	35	69
10	Endothal	1.5 qt.	None	65	47	16	63	32	67
9	Paraquat	1 qt.	95	53	31	24	62	44	70
2	Paraquat	2 qt.	100	23	17	23	63	40	65
13	Phytar 560	0.6 qt.	5	69	48	13	63	36	68
7	Phytar 560	1.25 qt.	5	70	53	15	64	35	64
6	Shed-A-Leaf 'L'	5 gal.	5	68	55	21	63	35	70
11	Solvent 52	40 gal.	35	71	52	15	62	38	70
5	Solvent 52	50 gal.	55	71	53	14	63	37	66
H1	Check	-	-	71	41	12	62	82	72
H2	Paraquat	1 pt.	85	27	15	15	63	80	71

weeks in April at the rate of 1/2 pound active ingredient per acre in 40 gallons of water is very effective. It has been used on several acres of seed production fields with no ill effects. It has been observed that the 1/2-pound rate at this location does not control the following weeds: sulphur cinquefoil, *Potentilla recta* L.; motherwort, *Leonurus cardiaca* L.; common mullein, *Verbascum thapsus* L.; and butter-and-eggs, *Linaria vulgaris* Hill.

This is a progress report; therefore no attempt should be made to reach conclusions from the information presented as to the use and recommendation for these chemicals.

***

Winter Survival and Spring Recovery of Clover and Trefoil Introductions

S. W. Braverman and D. D. Dolan (Geneva)

White Clover Introductions. The following white clover introductions were rated good to excellent in both percentage winter survival and spring recovery at the Plant Introduction Station, Geneva, on May 11, 1970 (planted in rod rows in the spring of 1969): P.I. 302973 (Spain), P.I. 303835 (USA), P.I. 311490 (Spain), P.I. 311494 (Spain), P.I. 314588 (USSR), P.I. 326144 (Iran).

The preceding white clovers, having rated better than satisfactory for percentage winter survival and spring recovery at the Plant Introduction Station, Geneva, should be further tested for agronomic characters and forage yield by cooperators in the Northeast.

Miscellaneous Perennial Clovers. Miscellaneous clover introductions planted in rod rows in 1969 were rated good to excellent in both percentage winter survival and spring recovery on May 11, 1970. Whereas the vast majority of red clover introductions were winter killed during the severe 1969-1970 winter, many of the miscellaneous perennial species were outstanding in winter hardiness. They are as follows: P.I. 314116, *Trifolium alpestre* (USSR); P.I. 206483, *T. ambiguum* (Turkey); P.I. 229624, *T. ambiguum* (Iran); P.I. 229625, *T. ambiguum* (Iran); P.I. 205314, *T. montanum* (Turkey); P.I. 258449, *T. ochroleucum* (Italy).

The above introductions of miscellaneous species of *Trifolium* should be further evaluated by cooperators in the Northeast.

Trefoil Introductions. The following introductions of *Lotus corniculatus* were rated good to excellent for both percentage winter survival and spring recovery on May 11, 1970. They are grown in rod rows from a planting set out in the spring of 1969: P.I. 187101 (Italy), P.I. 296318 (Brazil), P.I. 303819 (USA), P.I. 303820 (USA), P.I. 303823

(USA), P.I. 304067 (Urug.), P.I. 304523 (Turkey), P.I. 305508 (Italy), P.I. 325379 (USSR), P.I. 329242 (Urug. via Australia), P.I. 331177 (Argentina).

The above introductions of trefoil, L. corniculatus, should be further tested for agronomic characters and for forage yield by cooperators in the Northeast.

Several other species of Lotus were rated good to outstanding in both percentage winter survival and spring recovery on May 11, 1970:

L. caucasicus:	P.I. 325369-72 (USSR), P.I. 325374-6 (USSR), P.I. 325378 (USSR)
L. pedunculatus:	P.I. 282155 (Chile), P.I. 282160 (Chile), P.I. 282164-5 (Chile), P.I. 300015 (Rep. S. Afr.), P.I. 308037 (Czech.)
L. frondosus:	P.I. 308035 (Czech.)
L. major:	P.I. 300016 (Rep. S. Afr.)

The above Lotus species, particularly L. frondosus, should be further tested for agronomic characters and forage yield by cooperators in the Northeast.

***

NORTH CAROLINA

Problems with Crownvetch Utilization in North Carolina

Will A. Cope (Raleigh)

Crownvetch plantings in the Piedmont and Mountain regions of North Carolina make spectacular growth after once becoming established. Spring growth is especially vigorous. During summer the dry matter production is somewhat dependent on the available water supply; however, crownvetch is one of the most drought-tolerant legumes that we have tested. On the other hand, experience with utilizing the crop, either for hay or grazing, has generally shown a fairly rapid stand loss. After one or two years, stands often are inadequate for continued production. Grazing seems to allow somewhat greater longevity than cutting for hay, particularly when the pasture is managed to avoid overgrazing.

Table 1 shows stand ratings of selections and varieties at three locations after 2 years of cutting for hay. In 1968 each test was cut routinely as it reached the proper hay stage. In 1969 a less drastic cutting program was followed to avoid increasing the stand loss that was evident at the beginning of the season. Test V-66-4 was the only one of the three tests to maintain a reasonably good stand after 2 years.

Table 1. Crownvetch stand percent for strains in three Piedmont tests. Stand ratings were made in the spring of 1970 after two harvest seasons.

Strain	Test Number		
	V-66-4	V-66-5	V-67-1
N.C. Sel. 1	84	53	53
N.C. Sel. 2	90	75	73
Penngift	64	48	37
Emerald	80	63	60
Chemung	78	60	30
Vol	--	80	63
Test Mean	79	63	53

There appears to be no one major cause of crownvetch stand depletion, but observations have indicated certain conditions which contribute to stand loss. Stands die out most quickly in poorly drained sites. Quite vigorous plants in poorly drained sites often do not recover after the first hay cut. Another striking loss of good stands occurs when vigorous growth is cut for hay in a mid-summer period of heavy rainfall. This was emphasized in an irrigation study in which plants with vigorous growth induced by irrigation failed to recover after harvest, while non-irrigated plants with sparse growth recovered well.

It also appears that crown and root diseases are associated with failure of plants to recover after summer hay cuts; however, the extent of disease losses isn't known. Several fungus diseases of crownvetch crowns and roots have been recognized by other researchers. The complete defoliation of the hay cut results in a sharp increase in soil temperature. The change from moderate to high soil temperature could conceivably induce an increased rate of fungal growth, especially under moist soil conditions resulting from frequent summer rains.

Invasion by summer weeds, especially crabgrass, is another factor in limiting crownvetch recovery after defoliation by hay and grazing harvests. The fast-growing annual weeds tend to crowd out the crownvetch, which is slow to recover from complete defoliation.

It is increasingly apparent that soil fertility level is important in crownvetch production and stand longevity. Crownvetch grows well without high fertility levels in a soil conservation role where it is not harvested. However, the removal of nutrients by normal harvesting procedures may result in mineral deficiencies unless an adequate fertility program is followed. The specific mineral requirements for crownvetch in North Carolina have not been determined by fertility experiments. Such tests are presently under way.

Current investigations are concerned with evaluation of the various factors contributing to stand loss in crownvetch plantings. The breeding program is concerned particularly with a recurrent selection program under soil, disease, and management conditions that will tend to eliminate the short-lived genotypes, leaving the more hardy genotypes for recombination.

Publications:

1. Cope, W. A. and R. H. Moll. 1969. Inheritance of yield, forage quality, and seed characteristics in sericea lespedeza. Crop Sci. 9:467-470.

2. Burns, J. C., W. A. Cope, L. Goode, R. W. Harvey, and H. D. Gross. 1969. Evaluation of crownvetch (Coronilla varia L.) by performance of beef cattle. Agron. J. 61:480-481.

3. Cope, W. A. 1969. Crownvetch - a new forage crop. N.C. Agr. Exp. Sta. Research and Farming 28(1-2):14.

***

OHIO

Birdsfoot Trefoil, Crownvetch, and Red Clover

R. W. Van Keuren (Wooster)

Varietal evaluation of birdsfoot trefoil and crownvetch are being continued. A medium red clover variety trial just completed has shown reasonably good second-year yields from Lakeland and RF-2, shown in Table 1. The other varieties yielded considerably less and were very weedy the second year.

Sod-seeding studies with birdsfoot trefoil are still underway. Satisfactory stands of trefoil were obtained by drilling with a grassland drill into Kentucky bluegrass sod. The grass competition was reduced by spraying 3- and 6-inch bands of paraquat, dalapon, and paraquat-dalapon mixture directly over the seeded rows at the time of seeding.

Other studies are being conducted to evaluate the effect of herbicide treatments for no-tillage wheat production in pasture vegetation and the effect of these treatments on the establishment of legume seedings. Satisfactory stands of birdsfoot trefoil are being obtained by broadcasting in the spring into the fall-seeded wheat. This procedure appears to offer promise for renovation of bluegrass pastures.

Table 1. Red clover variety trial, 1968-69 summary, Wooster, Ohio. Seeded April 19, 1967. Average 4 replications.

Variety	Yield in tons per acre of dry matter 1968 Yield 2 cuts[1/]	1969 Yield 2 cuts[1/]	Avg. % Weeds 1969[2/]
Lakeland	4.20	2.77	14
RF-2	3.69	2.55	17
Ohio common	3.61	1.59	47
Ohio common	3.38	1.09	66
Chesapeake	3.12	1.40	57
Kenland	3.10	.52	78
Pennscott	3.05	1.09	59
L.S.D. - .05	.32	.46	
C.V. - %	9.27	29.07	

1/ Red clover yield only, not including weeds.

2/ Average percent weeds in the two cuttings, 1969.

Publications:

1. Van Keuren, R. W. and M. H. Niehaus. 1970. Ohio Forage Crop Evaluation Tests for 1969. Ohio Agr. Res. and Dev. Center, Agron. Dept. Series No. 195:1-14.

2. Van Keuren, R. W. and G. B. Triplett. 1970. Seeding legumes into established grass swards. Proc. XI Grassland Congress, p. 131-134.

3. Myers, D. K., G. B. Triplett, and R. W. Van Keuren. 1970. No-tillage wheat production and pasture renovation. Weed Sci. Soc. Amer. Abstr.

***

Development of Crownvetch (Coronilla varia) Seedlings as Influenced by Soil pH Levels

Lowell E. Moser and Roger R. Wallace (Columbus)

Crownvetch was seeded at pH 3.9, 4.2, 5.4, 6.8, and 7.4 in a greenhouse experiment. Soil with a pH of 3.9 was used and sufficient lime was added to bring the pH levels up to treatment levels. The silt loam soil used had 38 lb P_2O_5 (medium to high) and 112 lb K_2O (low per acre as determined by an initial soil test.

Crownvetch Seedling Development at Five pH Levels

pH	Days to Emergence	Days to Primary seed leaf	Days to First pinnate leaf[1]	Height of Topgrowth[2]
				cm
3.9	22	40	97	1.4
4.2	9	26	84	2.8
5.4	7	23	71	4.3
6.8	5	23	73	3.0
7.4	7	24	72	2.8

[1] Refers to first leaf containing more than 3 leaflets.

[2] Height 60 days after seeding.

In general, crownvetch seedling development occurred most rapidly at pH 5.4, 6.8, and 7.4. There was very little difference in development between these pH levels.

Established crowns were placed in pots containing soil at the pH levels mentioned previously. Growth was reduced severely at pH 3.9 and 4.2, and it occurred best at pH 5.4, 6.8, and 7.5.

***

PENNSYLVANIA

A New Disease Found on Crownvetch

R. B. Carroll and F. L. Lukezic (University Park)

Crownvetch (Coronilla varia) is utilized extensively as roadside planting stock in the northeastern United States for slope stabilization and control of soil erosion. Plants at several locations in central Pennsylvania were observed to be dying from a basal stem rot during the summers of 1965, 1966, and 1967. Symptoms were expressed as a chlorosis of the foliage, wilting, and death of the entire aboveground portion of the plant. Sclerotia were found in large dead stems.

An investigation into the cause of the disease was started by making numerous isolations from necrotic tissues and sclerotia. Pathogenicity tests were conducted in the greenhouse and growth chamber on four different clonal lines of 6-week-old 'Penngift' crownvetch and 6-month-old 'DuPuits' alfalfa.

The isolations consistently yielded a fungus morphologically similar to known cultures of Sclerotinia trifoliorum. It also fit a published description of this fungus isolated from ladino clover. This, along with the evidence of pathogenicity studies (described below), led to the conclusion that the disease is caused by S. trifoliorum.

In the pathogenicity tests, abundant mycelial growth was evident on the soil surface and plant stems 1 week after inoculation. The crownvetch plants showed moderate to severe wilting and chlorosis 14 to 19 days later. Basal stem rot and root rotting were also well advanced by this time, with death of the plant usually occurring soon after. Isolations made from the necrotic tissue consistently yielded the test fungus. The effect of the fungus on the root system and fresh weight of the plant is shown in table 1, which also points out the differences in susceptibility of the crownvetch clonal lines tested. This factor should be considered in making future selections.

Two pathogenicity studies conducted during the past year have led to the suggestion that isolates of S. trifoliorum obtained from crownvetch and alfalfa are not specific for either host. In the first study, an original isolate of S. trifoliorum from crownvetch (C-6) was tested for pathogenicity on 6-month-old alfalfa plants (cv. DuPuits, Vernal, and Saranac). The isolate had been maintained by storage in a sterile soil mix at 0 to 5 C, and inoculation procedures were the same as those previously employed. The inoculated plants exhibited a great amount of die-back of the foliage and root and crown damage as illustrated in table 2. 'Saranac' appeared to be somewhat more resistant than the other two cultivars tested.

Table 1. Decay index and fresh weights of crownvetch plants inoculated with *S. trifoliorum*.

	Clonal lines of Penngift crownvetch							
	1004		1006		618		627	
	Index[a]	Fresh Wt.	Index	Fresh Wt.	Index	Fresh Wt.	Index	Fresh Wt.
Inoculated[b]	2.7	5.8	4.7	5.1	5.3	4.0	4.0	6.8
Control[c]	2.0	9.2	2.0	14.9	1.5	15.3	2.0	20.2

[a] 1, no apparent damage; 2, slight browning of crown and feeder root system; 3, crown discolored and feeder root system reduced slightly; 4, crown black, feeder root system greatly reduced; 5, active cortical rot; 6, main and feeder root system completely rotted.

[b] Average of three observations.

[c] Average of two observations.

Table 2. Root and crown decay index[a] of three alfalfa varieties inoculated with a crownvetch isolate of *S. trifoliorum*.

	Variety of alfalfa					
	Saranac		Vernal		DuPuits	
	Avg.	Range	Avg.	Range	Avg.	Range
Inoculated[b]	3.2	2.0 - 5.0	4.2	2.0 - 6.0	4.7	3.0 - 5.0
Control[c]	1.0		1.0		1.0	

[a] 1, no apparent damage; 2, slight browning of crown and feeder root system; 3, crown discolored and feeder root system reduced slightly; 4, crown black, feeder root system greatly reduced; 5, active cortical rot; 6, crown, main, and feeder root system completely rotted.

[b] Saranac = average index of 13 plants; Vernal = average index of 19 plants; DuPuits = average index of 18 plants.

[c] Average index of 6 plants for each variety.

In the second study, 'Saranac' alfalfa and 'Penngift' crownvetch were both inoculated with the crownvetch isolate of the fungus (C-6) and a known culture of S. trifoliorum obtained from alfalfa (A-3). The alfalfa isolate had been maintained in the same manner as the crownvetch isolate. Both hosts exhibited foliar symptoms by the end of 3 weeks. At the conclusion of the experiment they both had considerable root and crown damage caused by both isolates of S. trifoliorum. This is shown in table 3. The pathogen was isolated from diseased host tissue in all cases but not from the alfalfa controls which showed a slight amount of root necrosis.

Table 3. Root and crown index[a] of alfalfa (cv. Saranac) and crownvetch (cv. Penngift) inoculated with an isolate of S. trifoliorum from both hosts.

	Host			
	Alfalfa		Crownvetch	
Isolate	Avg.	Range	Avg.	Range
A-3[b]	3.7	2.0 - 6.0	4.3	4.0 - 5.0
C-6[c]	3.9	3.0 - 6.0	4.4	3.0 - 6.0
Controls[d]	1.4		1.0	

[a] 1, no apparent damage; 2, slight browning of crown and feeder root system; 3, crown discolored and feeder root system reduced slightly; 4, crown black, feeder root system greatly reduced; 5, active cortical rot; 6, crown, main, and feeder root system completely rotted.

[b] Average index of 37 alfalfa plants and 7 crownvetch plants.

[c] Average index of 42 alfalfa plants and 7 crownvetch plants.

[d] Average index of 15 alfalfa plants and 3 crownvetch plants.

Publications:

1. Carroll, R. B., F. L. Lukezic, and J. M. Skelly. Evidence that isolates of Sclerotinia trifoliorum from crownvetch (Coronilla varia) and alfalfa (Medicago sativa) are not specific for either host. (Reviewed and submitted to Plant Disease Reporter 6/2/70).

2. Skelly, J. M., R. B. Carroll, and F. L. Lukezic. 1968. A new disease of crownvetch, Coronilla varia, caused by Sclerotinia trifoliorum. Plant Dis. Reptr. 52:882-886.

3. Skelly, J. M., R. B. Carroll, and J. H. Graham. 1968. Sclerotinia trifoliorum pathogenic on crownvetch. Phytopathology 58:403 (Abs.).

***

SOUTH CAROLINA

Trifolium Studies

O. W. Barnett, Chi-Chang Chen, and Pryce B. Gibson (Clemson)

Reproductive and Cytological Characteristics of Trifolium uniflorum. The reproductive characteristics of *T. uniflorum* plants from three sources (P.I. 330361, P.I. 341938, and P.I. 341939) were studied. The 36 plants studied were classified for compatibility as: 30 highly self-incompatible, four intermediate that set five or more seed on 10 self-pollinated florets, and two highly self-compatible. One plant shed no pollen although the anthers contained about 5% plump stainable grains.

To determine if manipulation of a self-compatible floret is needed for seed production, the seed produced by 10 manipulated and 10 nonmanipulated florets on a highly self-compatible plant were counted. Manipulation consisted of simulating bee visitation by carefully inserting the point of a lead pencil until contact was made with the stigma. The 10 manipulated florets produced 48 seed. The 10 nonmanipulated florets produced 34 seed.

T. uniflorum has a somatic number of $2n = 32$ chromosomes, of which 28 are submetacentric and four are subtelocentric. The latter four possess satellites. The chromosomes form almost exclusively quadrivalents and bivalents at metaphase I. The high frequency of quadrivalents (4.46 per microsporocyte) suggests an autotetraploid origin.

Compatibility Studies Involving T. nigrescens Viv., T. petrisavii Clem., and T. meneghinianum Clem. Hossain (Hossain, M. A revision of *Trifolium* in the nearer east. Notes from the Royal Botanic Garden, Edinburgh, 23:387-481. 1961) and Coombe (Coombe, D. E. *Trifolium* L. *In* T. G. Tutin (Chairman), Vol. 2. Flora Europaea. Cambridge U. Press. p. 164-172. 1968) question the justification of three species. They propose one species which they divide into subspecies and varieties.

For convenience in discussing plants of this complex we are using the terminology for three species. Briefly, the characteristics used to classify the plants into the three groups were:

1. *T. nigrescens* - ovules per pod usually 4, pods narrowly constricted between seeds.

2. *T. petrisavii* - ovules per pod usually 2, pods deeply constricted between seeds, stems slender.

3. *T. meneghinianum* - ovules per pod usually 2, pods deeply constricted between seeds, stems large and hollow.

We crossed plants of the three groups in the three possible combinations and obtained the following number of plants:

Crosses between T. nigrescens and T. petrisavii - 31 plants from 2160 florets pollinated.

Crosses between T. nigrescens and T. meneghinianum - 224 plants from 2160 florets pollinated.

Crosses between T. petrisavii and T. meneghinianum - 68 plants from 2160 florets pollinated.

Obtaining hybrids from the three combinations gives some support to the proposal for one species. However, almost all hybrid plants from crosses between T. nigrescens and T. meneghinianum exhibited some degree of chlorophyll deficiency. Variable amounts of aborted pollen occurred in hybrid plants from all crosses.

The three groups of plants were also crossed with the perennials T. occidentale and T. repens. We definitely obtained hybrids from crosses of these perennial species with T. nigrescens and T. petrisavii but do not know if we have obtained a hybrid with T. meneghinianum. Four questionable plants will have to be examined cytologically and progeny tested if possible to determine if they are hybrids.

The occurrence of chlorophyll deficiencies and aborted pollen in the hybrid plants and the apparent difference in crossability with the perennial species, T. repens and T. occidentale, indicate that rather strong differences exist among the groups of the T. nigrescens complex.

Virus Susceptibility of Some Trifolium Species. The ability to make interspecific crosses with T. repens may permit the introduction of virus disease resistance into T. repens. Several Trifolium species closely related to white clover have been inoculated with clover yellow vein (CYVV), bean yellow mosaic virus (BYMV), red clover vein mosaic (RCVMV), clover yellow mosaic (CYMV), white clover mosaic (WCMV), alfalfa mosaic (AMV), and peanut stunt (PSV) viruses. In preliminary trials, T. repens and T. occidentale were not infected with BYMV; T. pallescens, T. rueppellianum, and T. occidentale were not infected with CYVV; T. pallescens, T. uniflorum, and T. rueppellianum were not infected with AMV; and T. pallescens, and T. uniflorum were not infected with PSV. RCVMV, CYMV, and WCMV infected all 12 Trifolium species inoculated.

Several plant introductions of T. repens reportedly possess resistance to certain virus diseases. Ten seedlings of P.I. 224680, 234450, 234678, 246751, 257495, and 302441 were mechanically inoculated with each of the seven viruses. All ten plants of all P.I. lines inoculated

with RCVMV, CYMV, and WCMV were infected. None of the P.I. lines were 100% infected by CYVV, AMV, or PSV. None of the plants were infected by the strain of BYMV used. Some, if not all, of the plants not infected by the above viruses by mechanical transmission may be capable of being infected by aphid transmission.

Publications:

1. Chen, Chi-Chang and Pryce B. Gibson. 1970. Meiosis in two species of Trifolium and their hybrids. Crop Sci. 10:188-189.

***

SOUTH DAKOTA

Stable Foam Volumes of Forage Species and Variety Mixtures

M. D. Rumbaugh (Brookings)

Two alfalfa varieties, birdsfoot trefoil, sainfoin, and Kentucky bluegrass were evaluated individually and in combinations of two entries per sample for stable foam volumes. The laboratory technique was based on that developed by W. A. Kendall (Kentucky) and the problem was suggested by the published report of the Montana researchers (C. S. Cooper, R. F. Eslick, and P. W. McDonald) indicating that combinations of legume species were not always additive in their effects on stable foam volumes.

Two subsamples of each of the 15 forage entries were run on each of 4 days in July. The plant materials were obtained from border rows of yield trials planted at Brookings. Table 1 contains these results.

The performance of the species followed the pattern previously observed at Brookings and other stations. The foam volumes of the two alfalfa varieties did not. In all other trials we have previously conducted, the stable foam volume of Travois has been lower than that of Vernal. I cannot explain the aberrant data shown here.

The differences among the individual varieties and also among the mixtures of varieties were statistically significant. Departures from additivity were highest in combinations of Vernal with sainfoin and bluegrass and with trefoil and bluegrass. Only in the case of sainfoin plus bluegrass did the mixture result in a higher foam volume than the higher component of the mixture when tested individually. Our experiences did not agree with the Montana data in which the addition of 1/2 g of sainfoin to 1 1/2 g of alfalfa nearly doubled foam production compared with 2 g of alfalfa alone.

Table 1. Mean stable foam Volumes (cc) of species and species mixtures Two subsamples on each of four days.

Forage	Daily Mean 7-11-69	7-16-69	7-17-69	7-21-69	Grand Mean	Departure from additivity
Species:						
Travois alfalfa	182	185	128	188	171	---
Vernal alfalfa	185	155	108	135	146	---
Empire trefoil	108	115	110	120	113	---
Eski sainfoin	12	40	50	18	30	---
Kentucky bluegrass	18	20	10	20	17	---
Mixtures: [1/]						
Travois + Vernal	165	142	115	178	150	- 8
Travois + trefoil	155	110	120	175	140	- 2
Travois + sainfoin	42	118	120	145	109	+ 9
Travois + bluegrass	112	102	120	45	95	+ 1
Vernal + trefoil	168	92	130	142	133	+ 3
Vernal + sainfoin	82	108	165	115	118	+30
Vernal + bluegrass	130	90	138	110	117	+35
Trefoil + sainfoin	20	78	100	22	55	-17
Trefoil + bluegrass	40	42	30	40	38	-27
Sainfoin + bluegrass	20	50	38	28	34	+10
Mean	96	96	99	99	97	+ 3
$W_{.05}$	20	22	52	39	32	
C.V. (%)	11	11	26	20	18	

1/ All mixtures were of equal quantities by weight of wet forage.

***

Legume Species and Variety Trials

M. D. Rumbaugh (Brookings)

Table 1. South Dakota Agricultural Experiment Station

1967 Trefoil Variety Test

Location	Brookings, S. D.	Plot Size:	4' x 20'
Design:	Randomized Block	Planting Date:	May, 1967
Method of seeding:	V-belt Drill	Replications:	4
Soil Type:	Vienna Loam	Years:	1967-1969

Entry	Percent Stand 5-6-69	Oven Dry Tons per Acre 1968 2 cuts	1969 6 cuts	Average Yield
Dawn	92	1.31	1.93	1.62
Empire (Mich. 240)	93	1.62	1.87	1.75
Empire (N.Y. Cert.)	94	1.47	2.08	1.77
Granger	20	.48	.83	.65
Import (Yugosl.)	48	.53	1.01	.77
Leo	91	1.44	1.92	1.68
Ia. E-1	92	1.32	1.82	1.57
Ia. R-1	90	1.43	2.03	1.73
Mo. 10	91	.96	1.94	1.45
Mo. 110	28	.57	.99	.78
NDL-45	80	.80	1.70	1.25
S.D. BFT Cycle II	92	1.22	2.03	1.62
MC-H-66	92	1.20	2.00	1.60
MC-F-66	93	1.21	1.98	1.60
V 15 (N.Y.)	73	.91	1.38	1.15
P-15456	97	1.47	1.94	1.71
N6-128	93	1.20	2.06	1.63
Purdue Syn.-A	*	.67	*	*
Test Mean	80	1.10	1.74	1.43
$^{W}(0.05)$	23	.66	.46	.37
C.V. (%)	11	23	10	14

* Entry with poor stand and contaminated with red clover was dropped from test in 1969.

Table 2. South Dakota Agricultural Experiment Station

1969 Pasture Legume Species Test

Location:	Brookings, S.D.	Plot Size:	4' x 20'
Design:	Split Plot	Planting Date:	May, 1967
Method of seeding:	V-belt Drill	Replications:	4
Soil Type:	Vienna Loam	Years:	1968-1969

Entry 1/	Legume Percent Stand 6-5-68	Legume Percent Stand 5-6-69	Oven Dry Tons per Acre 1968 2 cuts	Oven Dry Tons per Acre 1969 5 cuts	Oven Dry Tons per Acre Average
Bromegrass:Travois alfalfa	93	100	2.36	2.85	2.58
Bromegrass:Eski sainfoin	83	10	1.33	1.20	1.27
Bromegrass:Penngift c.v.	11	28	1.44	1.39	1.43
Bromegrass:Emerald c.v.	11	35	1.52	1.42	1.48
Bromegrass:Chemung c.v.	10	30	1.49	1.39	1.45
Bromegrass:Empire b.f.t.	16	88	1.77	1.96	1.84
Bromegrass:Leo b.f.t.	16	90	1.76	1.94	1.82
Bromegrass:NDL-45 b.f.t.	6	55	1.36	1.61	1.48
Bromegrass:Mich.-240 b.f.t.	9	80	1.55	1.85	1.68
Bromegrass:Dawn b.f.t.	13	80	1.68	1.78	1.71
Mean	27	60	1.63	1.74	1.67
$^{W}(0.05)$	12		.38	.34	.21
C.V. (%)	17		9	8	7

1/ Seeding rates in lbs./acre:

alfalfa	12
sainfoin	18
crown vetch	12
trefoil	12
bromegrass	6

Table 3. South Dakota Agricultural Experiment Station

1967 Sainfoin Test

Location:	Brookings, S.D.	Plot Size:	4' x 20'
Design:	Randomized Block	Planting Date:	May, 1967
Method of Seeding:	V-belt Drill	Replications:	4
Soil Type:	Vienna Loam	Years:	1968-1969

Entry 1/	Percent Stand 5-6-69 Legume	Grass	Oven Dry Tons per Acre 1968 2 cuts	1969 6 cuts	Average
Varieties:					
Eski sainfoin	60		1.01	1.33	1.17
Travois alfalfa	98		2.84	3.41	3.13
Manchar bromegrass		92	1.61	1.26	1.44
Fairway created wheatgrass		80	.88	1.31	1.10
Oahe intermediate		85	1.50	1.17	1.33
Vinall Russian wildrye		25	.91	1.22	1.07
Sainfoin mixtures:					
Sainfoin:bromegrass	4	75	1.82	1.27	1.55
Sainfoin:crested	31	45	1.02	1.29	1.16
Sainfoin:intermediate	12	75	1.40	1.19	1.29
Sainfoin:wildrye	48	6	.97	1.04	1.00
Mean			1.30	1.20	1.25
Alfalfa mixtures:					
Alfalfa:bromegrass	76	45	2.71	2.99	2.85
Alfalfa:crested	95	50	2.67	3.33	3.00
Alfalfa:intermediate	68	35	3.92	3.04	2.98
Alfalfa:wildrye	95	9	3.08	3.31	3.19
Mean			3.09	3.17	3.00
Test Mean			1.88	1.94	1.88
$^{W}(0.05)$			1.51	.47	.68
C.V. (%)			32	9	20

1/ Seeding rates: Alfalfa 10 g/plot
Sainfoin 20 g/plot
Grasses 10 g/plot
1/2 of above when in mixture

Table 4. 1968 Brookings Clover Test. RCB design, 2 replications of 4' x 20' plots. Seeded May 1, 1968. Test area treated with 1 pound per acre Benefin preplant.

Entry	Percent Stand 5-6-69	Oven Dry Tons per Acre 1968 2 cuts	1969 6 cuts	Average
Dollard red clover F.C. 39,394	100	2.18	2.93	2.55
S.D. Exp. Alba clover	79	.76	1.86	1.31
Lakeland red clover F.D. 39,395	99	2.20	2.79	2.50
Merit white clover F.D. 39,719	100	1.78	2.61	2.19
Ladino white clover F.D. 39,727	100	1.66	2.28	1.97
Idaho alsike clover F.C. 38,922	93	1.24	1.97	1.60
Kura clover F.C. 39,742	20	.22	.42	.32
Large Hop clover F.C. 39,642	**	1.18	****	****
N.Z. Small Hop F.C. 39,540 1/	73	.80	2.03	1.41
Wilton Rose clover F.C. 39,560	**	1.94	****	****
S.D. Exp. Brookings rose clover	**	1.84	****	****
Zig Zag clover F.C. 39,743	45	.76	1.40	1.08
Bacchus marsh subt. F.C. 39,583	**	2.87	****	****
Mt. Barker subt. F.C. 39,584	**	2.68	****	****
Mississippi sub. F.C. 39,557	**	1.60	****	****
Means	79	1.58	2.03	1.66
$W_{(0.05)}$	30	.90	.36	.38
C.V.(%)	16	14	7	10

1/ Entry appears to be white clover

**Annual species not used in computing averages.

TENNESSEE

John H. Reynolds (Knoxville)

Publications:

1. Reynolds, John H. 1969. Persistence and reseeding of red clover. Tenn. Farm and Home Sci. No. 72.

2. Gray, Elmer and John H. Reynolds. 1970. Effect of stage of maturity on yield and leaf content of annual lespedeza. Tenn. Farm and Home Sci. No. 74.

***

VIRGINIA

Clipping Management Affects Seed Yields of Crownvetch

John D. Miller, ARS (Blacksburg)

Four managements, namely clipping in mid-May, early June, at flowering, and none, were used on a relatively uniform stand of Penngift crownvetch in 1969. The main objective was to determine if satisfactory seed yields could be obtained without excessive production of green material which is difficult to process in a combine.

Highest seed yields were obtained with no clipping, but clipping in mid-May did not seriously reduce seed yields. A considerable reduction was noted in green matter production when plants were clipped, but this may have not been of economic importance. Ripe seed was produced only by plants clipped in mid-May or not clipped at all.

Seed quality was also studied. Highly significant decreases in number of seed per umbel and weight per 100 seed was caused by clipping in mid-May as compared to unclipped plots.

Publications:

1. Miller, John D. 1969. Cross-compatibility of birdsfoot trefoil, *Lotus corniculatus* L. Crop Sci. 9:552-555.

***

SPECIES INDEX

***